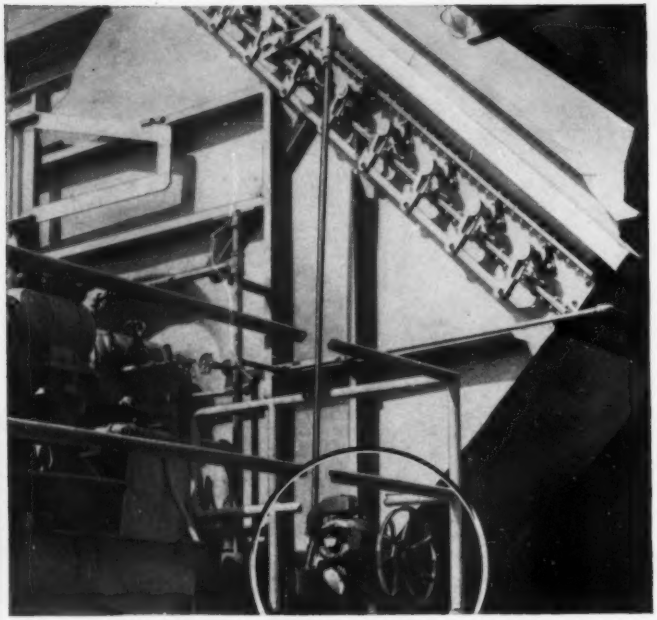
GENERATION, TRANSMISSION AND UTILIZATION OF ELECTRIC POWER SERVICE • A McGRAW-HILL PUBLICATION

May 1951

Power

Night watch on industry's lifeline — p 67



In a semi-outdoor station, Metermax drive unit (in circle) connected to damper, needs no protection against weather—never freezes or clogs.

Electric Muscles for Better Combustion Control

Take a close look at the parts of a combustion control system that do the actual moving of dampers, vanes and other controlled elements. They're mighty important to the overall performance of the control. In the Metermax system, you'll find all these jobs done by electric drive mechanisms, selected for these outstanding features:

Dependable Power Source: Operate from plant power lines, independent of compressed air supply.

Self-Locking: double worm and gear drive can't be backdriven by unbalanced dampers; no locking devices needed.

Self-Releasing: no unlocking or resetting by operator when resuming manual control after shutdown.

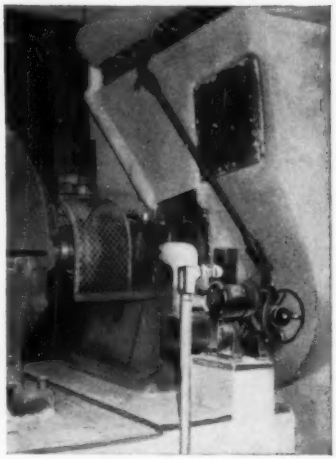
Simple Remote Control: instantaneous transfer from automatic to remote manual operation; no reset position.

Easy Manual Operation: handwheels built into each unit give ample mechanical advantage for moving heavy loads.

True Position Indication: electric indicator on panel responds only to movement of drive shaft; no errors due to friction or sticking of dampers.

Outdoor Service: no clogging or freezing troubles; no steam jacketing or weather shelter ever necessary.

Our new Folder NU9-463(1) gives full details about Metermax electric drive units. For a copy, write to Leeds & Northrup Company, 4910 Stenton Avenue, Philadelphia 44, Pa.

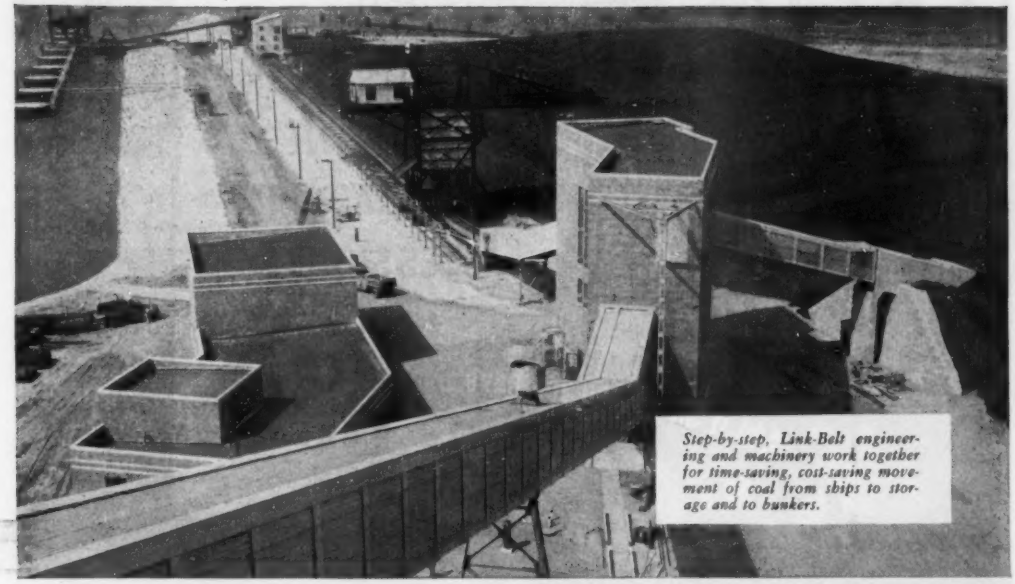


Drive units have built-in mounting feet; are readily bolted to steel or concrete base. Crank and connecting link are supplied with each unit.

LEEDS & NORTHRUP

Journal ad NU9-01-463(4)

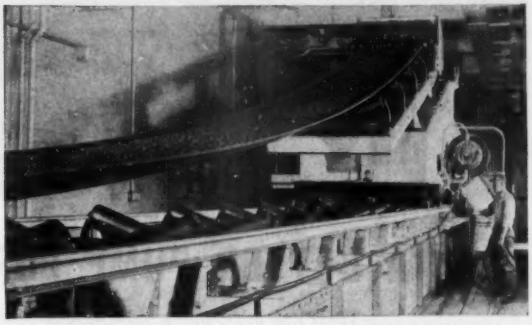
LINK-BELT engineering...



Step-by-step, Link-Belt engineering and machinery work together for time-saving, cost-saving movement of coal from ships to storage and to bunkers.

LINK-BELT equipment...

...combine to cut coal handling costs — from unloading to delivery to power plant bunkers



Link-Belt answers a vital need for the more efficient handling of coal in power plants—large and small. Here a Link-Belt Belt Conveyor and motor-operated traveling tripper distribute coal to bunkers through a dust-tight bin seal.

YOU name your coal handling problem—look to Link-Belt for the answer! Based on experience gained in hundreds of installations in power plants everywhere—Link-Belt has the facilities, the proven equipment, the engineering know-how to carry the ball from start of operations planning to delivery of coal. Regardless of the size of your plant—Link-Belt engineers can recommend exactly what you need for more efficient coal handling.

Conveyors, elevators, feeders, car dumpers and shakers, screens, hoists, hoppers, chutes, gates, stackers, unloading towers, weigh larries and related power plant equipment and accessories—all can be supplied by Link-Belt—*the most complete line* in the field.

So for simpler, more efficient, increased capacity coal handling methods—lower operating and maintenance costs—call on Link-Belt.

Our engineers will cooperate with you or your consultants to find the most economical solution for your problems. Write for details.

12.204

LINK-BELT COMPANY Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Johannesburg. Offices in Principal Cities.

LINK-BELT
COAL HANDLING EQUIPMENT

A BETTER PUMP FOR OIL BURNERS

There's no other pump quite so satisfactory as the IMO for oil burner service because there is no other pump built just like the IMO – the only positive displacement, rotary pump with no vanes, valves or pilot gears.

The IMO can be direct-connected to high speed motors or turbines; it requires no reduction gearing; occupies but little space; and operates smoothly, quietly and efficiently.

For your next oil burner job be sure of the best . . . specify the new low cost IMO A313A.

Bulletin on request.

IMO-DE LAVAL PRODUCTS DIVISION

DE LAVAL STEAM TURBINE CO., TRENTON 2, N. J.

DE LAVAL

TURBINES • HELICAL GEARS
CENTRIFUGAL BLOWERS AND COMPRESSORS • CENTRIFUGAL PUMPS • WORM GEAR SPEED REDUCERS • IMO OIL PUMPS

6-160

Power

MAY 1951 VOLUME 95 NO. 5

combined with Operating ENGINEER

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(Member ABC and ABP)

POWER (with which are consolidated *Science and Industry, The Engineer Review, The Engineer, The Stationary Engineer* and *Operating Engineer*) is published monthly with an additional directory number in June, by McGraw-Hill Publishing Company, Inc., James H McGraw (1860-1948), Founder. PUBLICATION OFFICE: McGRAW-HILL BUILDING, 330 W 42ND ST, NEW YORK 18, N. Y.

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POWER articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own index annually, copies of which are available on request to the editorial offices.

"NIGHT WATCH," our May cover, silhouettes Dunkirk Station of Niagara Mohawk Power Corp against a Lake Erie evening sky. In this color shot, Frank T Sobeck has, we think, strikingly symbolized the 24-hr job of power men in our defense mobilization. And Dunkirk makes a particularly good symbol—it's one of the world's most efficient plants.

Frank, veteran estimator in Combustion Engineering-Superheater Inc's proposition dept, has made a lifelong hobby of photography. Recently he's been putting this hobby to work by journeying to current Combustion jobs, picturing them for the record. We're proud to have one of his best efforts for our first full-color cover.

Next month . . .

■ Most of us admit that standardization saves time and dollars, and that right now both look extra good. But we're apt to doubt when it comes to applying standards in power plants. Watch for an article in June that may change your thinking on this score.

■ And keep an eye out for another roundup by Sheppard T Powell—this time on the various forms of chemical feeders used for water treatment.

■ Don Swift, Ebasco Services, does every day what most of us do once or twice in a lifetime—starts up new power plants. In a series of "shorts" he tells of unusual "bugs" and how the little mysteries they represent were solved in actual cases.

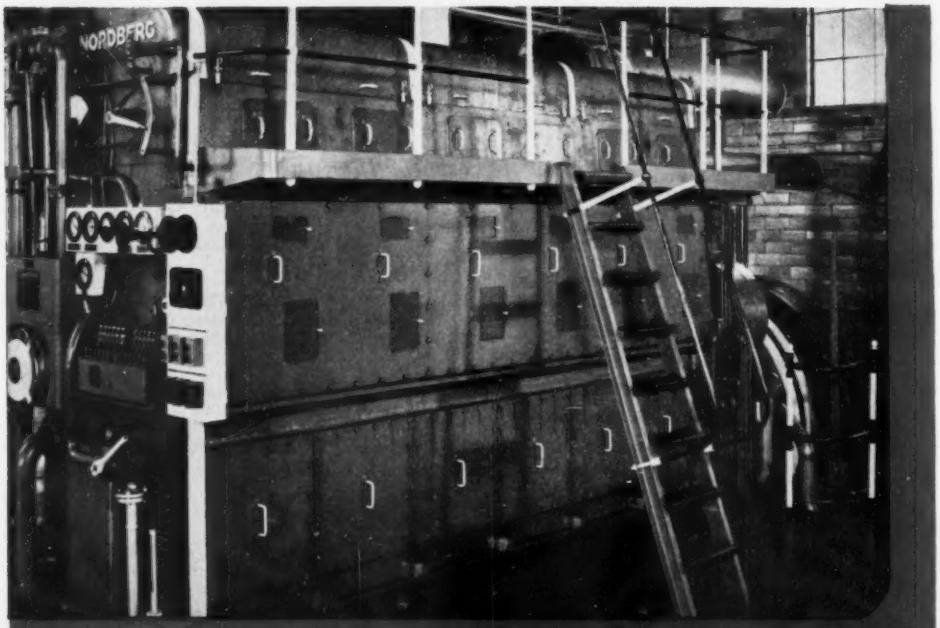
■ With summer almost here, it's time to lay up that heating boiler. The next Operator's Notebook tells how to do the job right.

. . . and future months

■ For some time we've been looking for good dope on machinery insurance—what it covers, how best to put it to work. We've got such a piece in hand now—you'll see it soon.

■ We're readying a new study course for POWER readers—it'll cover, in easy-to-read style, what schools call *thermodynamics*, what we call *heat-power*.

ASSURE THRIFTY POWER



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This means free rings, open ports and properly functioning valves for better compression and combustion—less fuel consumption. Wear is reduced . . . bearings and all moving parts last longer . . . maintenance costs go down.

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A Texaco Lubrication Engineer will gladly help you protect your Diesel investment with effective lubrication. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

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FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

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Power

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...with Power readers...

OOPS, SORRY! . . .

I have just received the March issue and have been studying the special-section "Power Handbook," which is very useful.

There is, however, a statement on p 99 which is incorrect. I refer to the following: "Pressure head, in feet, equals 0.433 times the pressure, in psi, divided by the specific gravity of the fluid."

This should read: "Pressure head, in feet, equals 2.31 times the pressure . . . " Or: "Pressure head, in feet, equals pressure, in psi, divided *by 0.433 times the specific gravity of the fluid."*

JUAN ANZIANI
Hato Rey, Philippine Republic

Reader Anziani is dead right and our faces are bright red. As you've guessed, we put the 0.433 in the numerator instead of the denominator and then failed to spot the error in at least four separate readings. We hope this is the only flaw in the job, but if you readers catch any more, please let us know promptly so we can include correction notes in Part II of the Handbook.—*Ed.*

"POWER . . . A BIG HELP!!"

When one of our editors walked into New York's old Produce Exchange Building the other day, he found Chief Engineer E Anderson reading at his old roll-top desk in the power plant.

(Continued on page 186)

...lines and bylines

MOIST AIR for stoker draft is an idea that has popped up many times before. Current interest in it as a means of reducing fireside deposits results from work done in a number of places. Prominent among them is Detroit Edison Co, whose Paul Murphy reported tests in an ASME paper that is the basis for our roundup in this issue (p 71).

Paul Murphy Jr

Paul, a 1941 Purdue graduate, went to Detroit in 1946 after the Navy released him to inactive duty. He became boiler-room engineer at Delray in Jan 1949. Paul entered the Navy as Ensign and left as Lt Commdr, after more than four years of service, supervising repairs on boilers, turbines, diesels, pumps, other power auxiliaries.

WORLD'S LARGEST axial-flow compressor (p 81) took a lot of engineering to bring to completion. Responsibility for later stages of manufacture, dynamic balancing and stress studies of this unit fell on Carl Wilcox, then head of the special products division of S Morgan Smith Co, builders. Carl was the proverbial "all-wool" engineer needed to bring off the job.

Carl J Wilcox

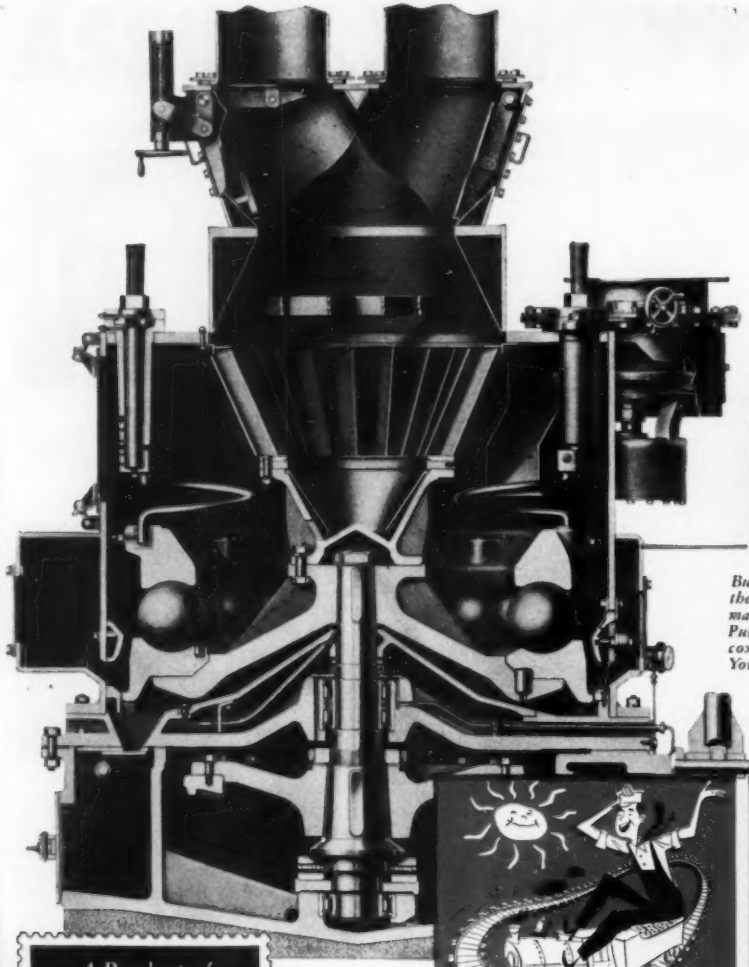
A 1934 Drexel electrical-engineering graduate, Carl was engineer, machinist and vocational-school teacher until he went with Budd Mfg Co in 1940. There he did research and survey work on the wind turbine sponsored by S Morgan Smith Co, then joined the latter company in June 1941. As office manager and test engineer, he remained at the Grandpa's Knob, Vt., site (POWER, June 1941, pp 55-59) until conclusion of experimental work. He later collaborated with Palmer Cosslett Putnam, wind-turbine inventor, in the documentary report, *Power from the Wind.*

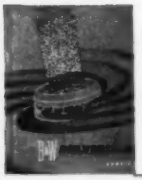
Transferred in 1947 to the home office at York, Pa., Carl worked on axial compressors, then became valve-division manager, in March 1950.

NIGHT AND DAY well describes the schedule followed by Mike Yunich in growing into his present power responsibilities at the Cleveland Graphite Bronze Co. He quit school young, began to earn a living in "black gangs" of Lake boats. But he soon turned to shore-plant jobs so he could get the technical education he wanted. Working days in various plants and burning midnight oil over night and correspondence courses, Mike got the know-how he needed in steam engineering, combustion and air conditioning.

Michael Yunich

Shortly after starting with Cleveland Graphite—some 12 years ago—he was put in charge of its new boiler plant. Using his natural savvy for running machinery and men, he's made this truly a "sweet" operation. Incidentally, his picture shows him putting some practical tips into POWER's sound recorder, for the article beginning on p 108. Still following a busy schedule, he somehow finds time for NAPE activities and his favorite leisure pastimes—golf, bowling and fishing.





Bulletin G-57 illustrates and describes the design, construction, operating, and maintenance features of the Type E Pulverizer. Write: The Babock & Wilcox Company, 85 Liberty Street, New York 6, New York.

A Product of B&W Engineering for Economy

Recirculating Load—Dries as It Grinds

Recirculation of fines within the mill gives repeated, quick-drying contact with large masses of heated air and metal . . . produces proper fineness at all loads, even with coal as wet as it can get. Fines are classified in the mill.

Uniform Performance Regardless Of Wear

Balls and grinding rings wear together . . . assure uniform fineness regardless of attrition of the grinding elements . . . fineness automatically increases at reduced loads.

A big asset in *low-cost* power generation

The only accurate measure of pulverizer efficiency—*and ultimate cost*—is a function of availability, plus combined materials and labor maintenance per ton of product over long periods of continuous operation. B&W recently surveyed a representative group of utilities, covering a wide geographical area and broad range of coals. More than 100 B&W Type E mills were reported in service from one to ten years, and with aggregate product of 25 million tons:

- Average Availability: 96.5%
- Average total maintenance cost per ton: 3.12 cents

It will pay you to remember this outstanding—and typical—history of dependable, low-cost performance when considering your next pulverizer installation.

Blows Clean Air—Saves Wear and Tear

Unique in pressurized operation, the Type E Pulverizer requires remarkably little maintenance of the primary fan, because it blows only clean air . . . is not subject to the damaging abrasion of entrained particles.

One-Point Variable Fuel—Air Control

Like the accelerator on your automobile . . . assures proper coal-to-air mixture . . . produces desired rate of steam generation over a wide range with coal conditions suitable for sustained high combustion efficiency.

Low Power Consumption

Ball-and-ring grinding, anti-friction bearings, pressure lubrication, and automatic rejection of ungrindable materials make possible high output with minimum power demand.

Outstanding Performance Record

Availability and maintenance economy beyond today's most exacting requirements are proved in over 1300 Type E Pulverizer installations.

Helping Industry Cut Steam Costs Since 1867

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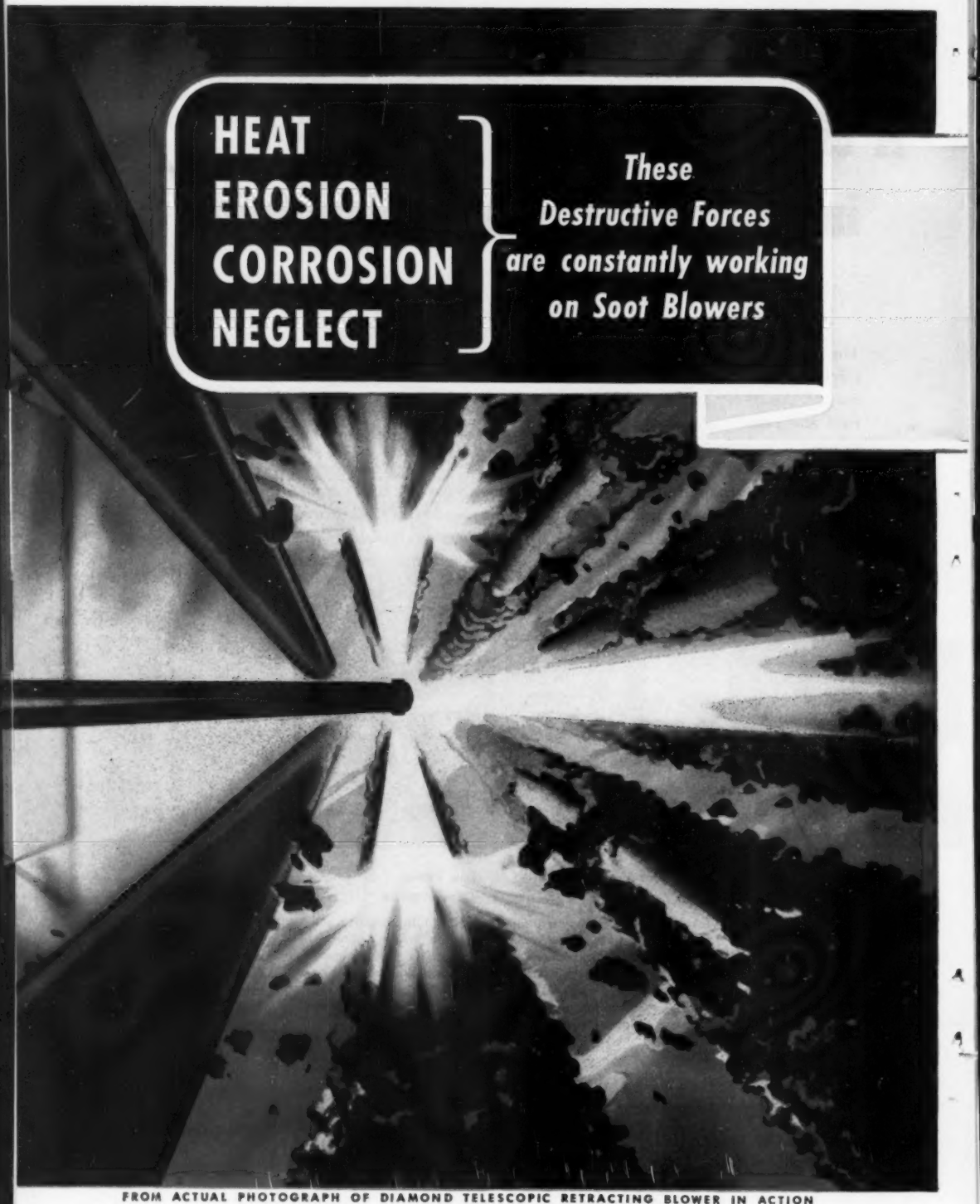

FROM ACTUAL PHOTOGRAPH OF DIAMOND TELESCOPIC RETRACTING BLOWER IN ACTION

This ad first appeared in the April 1940 issue of "Power". Its message is even more important today!

That's why you need the BEST SOOT BLOWERS MONEY CAN BUY!

No other equipment in the power plant has so much demanded of it as have the soot blowers. Soot blowers receive less attention than anything else—must meet conditions of heart-breaking severity—rarely get even so much as a drop of oil. Heat, erosion, corrosion, neglect—all these destructive forces are at them continually.

Yet, soot blowers are expected to do their work—instantly—efficiently—any time—month after month and year after year.

Their installed cost is only a minor portion of the cost of any power plant, so—

Why try to save on the capital cost of anything of which you expect so much? Certainly the very best you can get is none too good for such an assignment. The great majority of power engineers have found that the extra values of Diamond Soot Blowers are worth far more than their slight additional cost.

Lancaster, Ohio

DIAMOND POWER SPECIALTY CORP., ~~Detroit, Michigan~~
DIAMOND SPECIALTY, LIMITED, Windsor, Ontario

Diamond Soot Blowers are Used in More Than 80% of All Modern Power Boilers

As true today as it was in 1940

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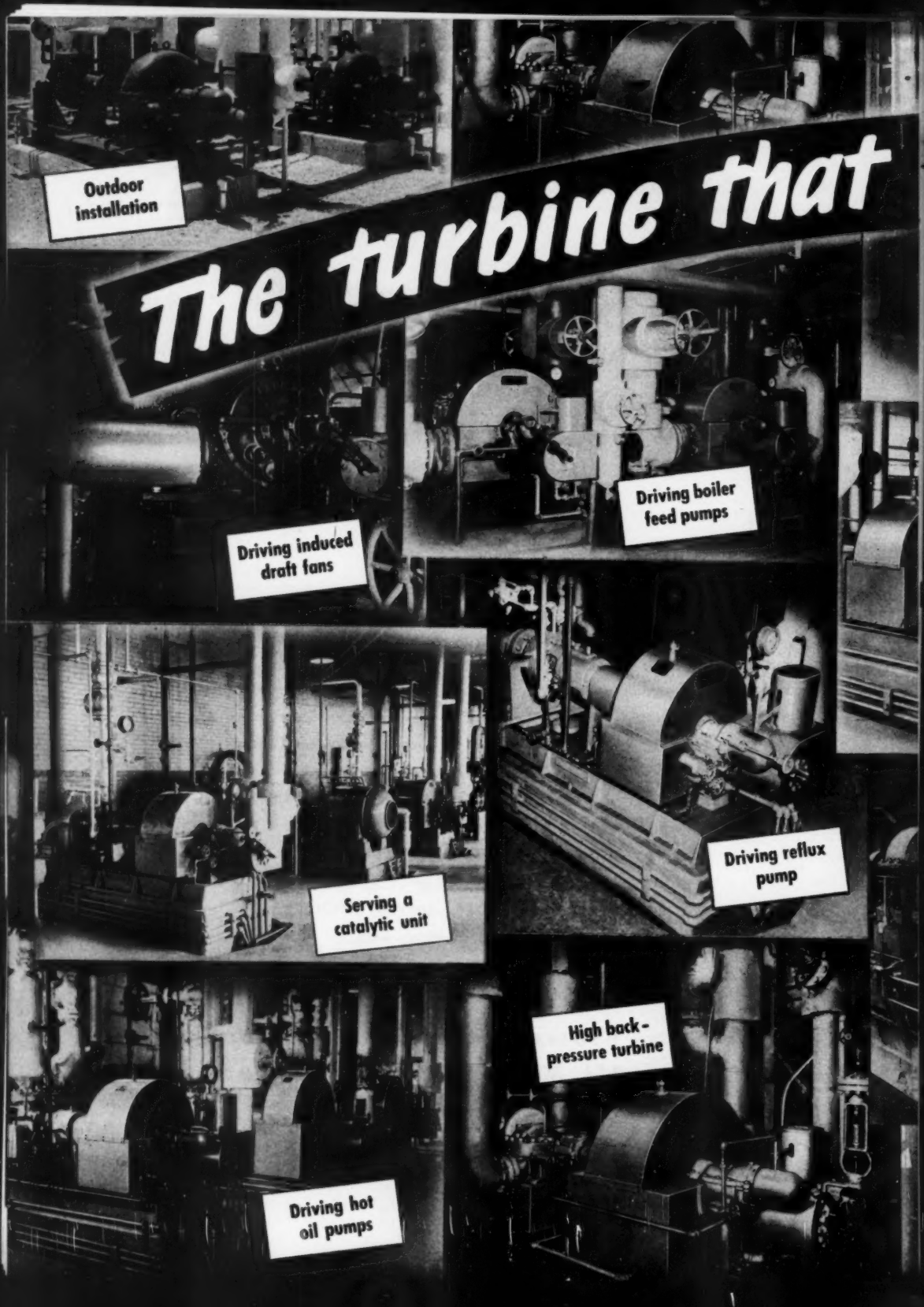
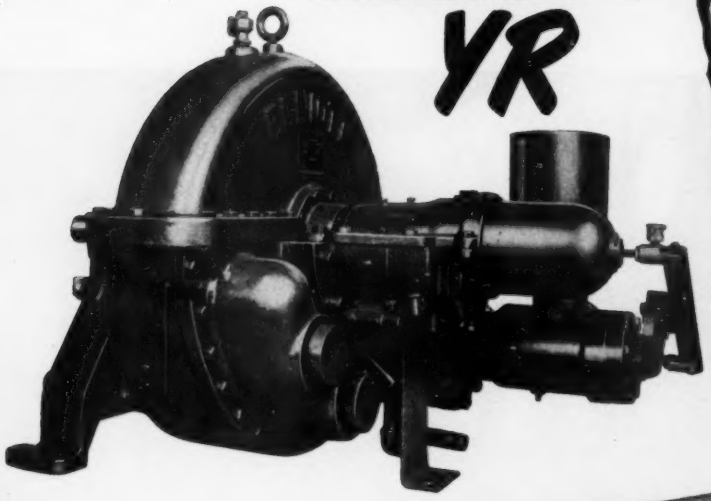

The turbine that
Outdoor installation
Driving induced draft fans
Driving boiler feed pumps
Serving a catalytic unit
Driving reflux pump
Driving hot oil pumps
High back-pressure turbine

everyone likes...

ELLIOTT YR



Driving induced draft fans

Paper machine drives

Driving process pumps

YOU SEE THEM EVERYWHERE—in power plants, industrial and process plants, throughout the oil industry, in fact in all industries that demand reliability in mechanical drive turbines. Working indoors or out, under all kinds of conditions, operating condensing or noncondensing; sometimes operating on gas instead of steam. Although a standardized line of turbines, their flexibility results in a tailor-made unit for any type of application . . . And best of all, with the built-in dependability that lightens the load of the men whose job is to keep things running right.

Everyone likes the Elliott YR. The reasons are factually set forth in Bulletin H-16. Write for it.

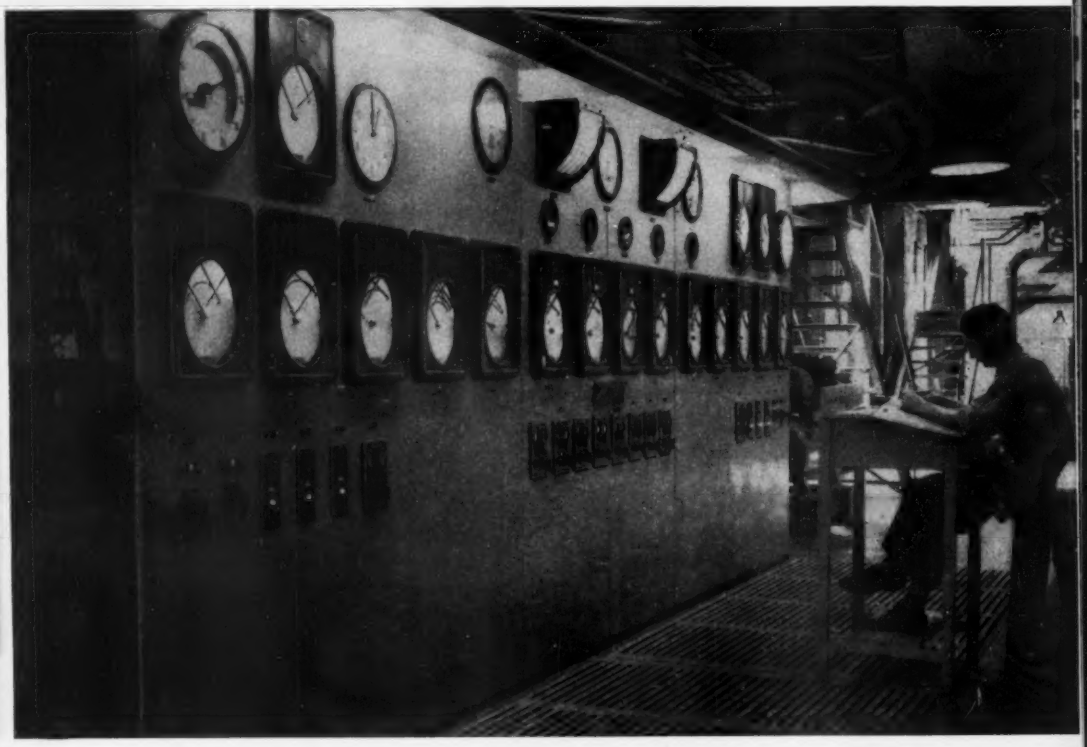
ELLIOTT COMPANY

Steam Turbine Dept. • Jeannette, Pa.

Plants at: JEANNETTE, PA. • RIDGWAY, PA. • AMPERE, N. J. SPRINGFIELD, O. • NEWARK, N. J. • DISTRICT OFFICES IN PRINCIPAL CITIES

H-730

What's YOUR Fuel-dollar



This Bailey Boiler Control Panel insures high efficiency in the use of Fuel-Dollars at a Western Chemical Plant. It includes Bailey Combustion Control, Bailey Three-Element Feed Water Control and Bailey Steam Pressure Reducing Control for two oil-fired boilers.

Controls for Steam Plants

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

Efficiency ?

A dollar's worth of fuel has the *same potential* energy, no matter who's boiler it fires. But how much of the energy actually gets converted to a usable form depends on how you operate your boiler.

That's where Bailey Controls can help. And, here's why, we believe, you'll get better fuel-dollar efficiency with Bailey:

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service—conveniently located near you.** Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

For better fuel-dollar efficiency—for more power per fuel-dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

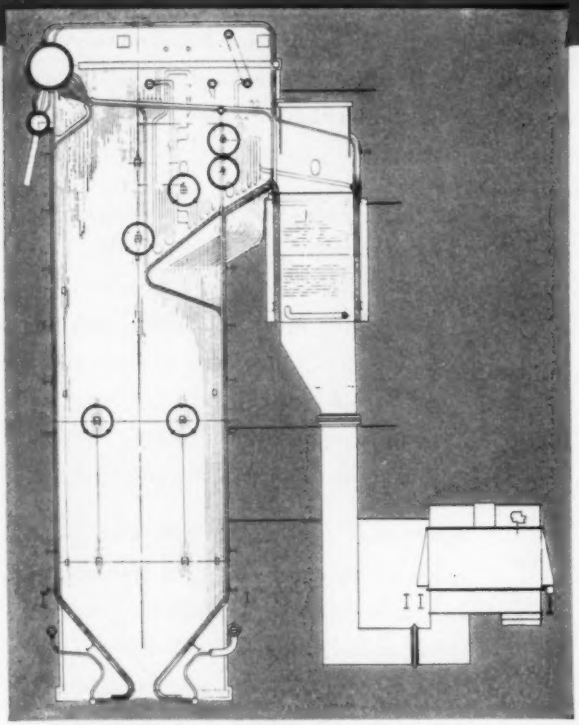
A-109

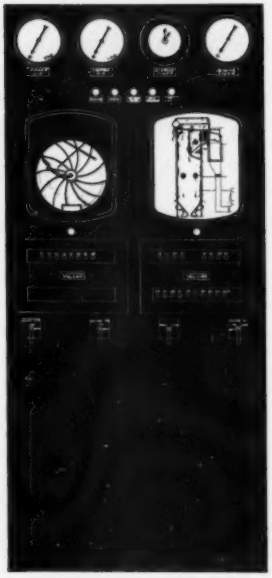
BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO

BAILEY METER COMPANY, LIMITED • MONTREAL, CANADA

PENELEC SWINGS to at its new





Penelec at Front Street is adding two Combustion Engineering-Superheater radiant type boilers fired with pulverized coal or oil, each rated at 400,000 pounds per hour at 1250 psi and 950 degrees FTT. Soot blowing will be by steam, with air-powered long retractables, rotary units, wall blowers and air-heater blowers under Vulcan Automatic-Sequential Control.

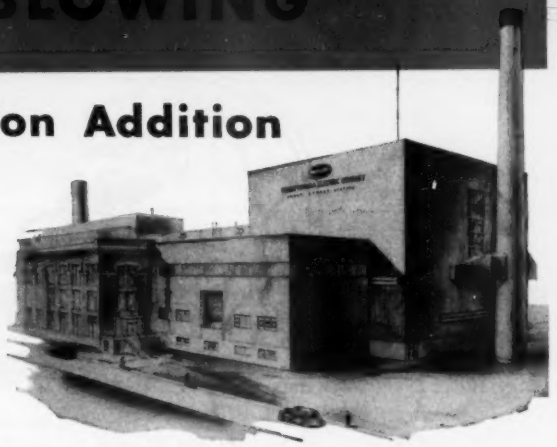
Lights on the boiler diagram will show that each blower operates in correct sequence and for the proper time. Centralized at the panel, soot blower control is flexible to meet any operating need.

VULCAN *Automatic*

VULCAN

AUTOMATIC—SEQUENTIAL SOOT BLOWING

Front Street Station Addition



Now using Vulcan on the 675-psi boilers at Front Street and Seward —and on 875 psi boilers at Warren —Pennsylvania Electric Company is swinging to Vulcan Automatic-Sequential Soot Blowers for the new 1250-psi boilers in the Front Street Station addition at Erie, Pa.

Better boiler cleaning is sure, because blower operation will be positive and at proper intervals.

Steam will be saved, since each blower will operate for exactly the correct cleaning period and no more.

Time will be saved, for operators will start the sequential soot blowers from the panel—no need to climb to remote locations.

Operation will be dependable, for complete protective devices are provided for all units.

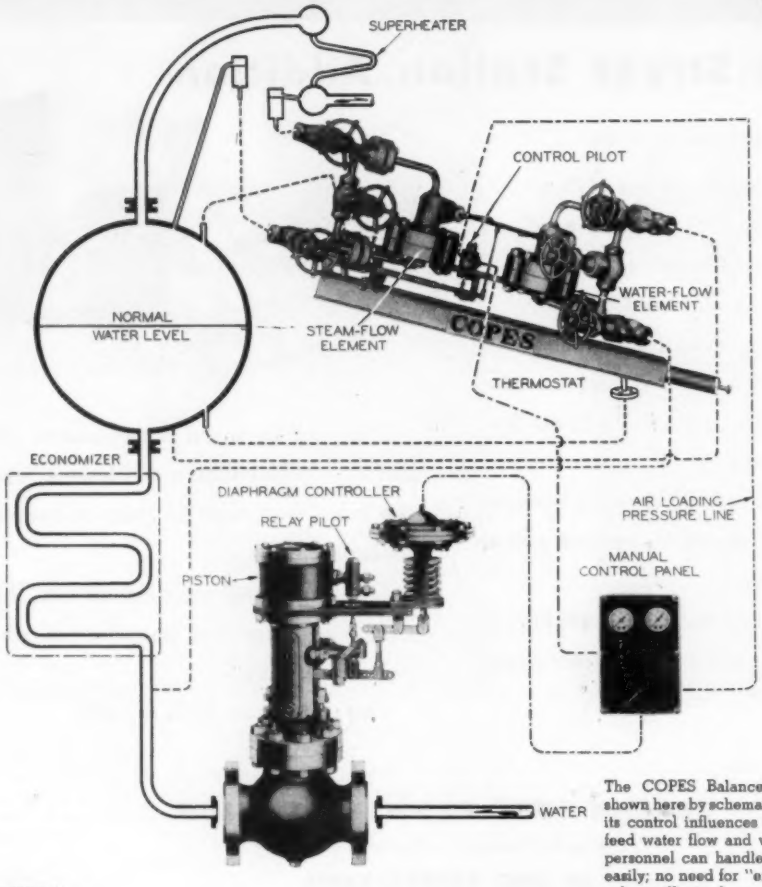
Get details in Bulletin 483.

VULCAN SOOT BLOWER DIVISION

Continental Foundry & Machine Company

DU BOIS, PENNSYLVANIA

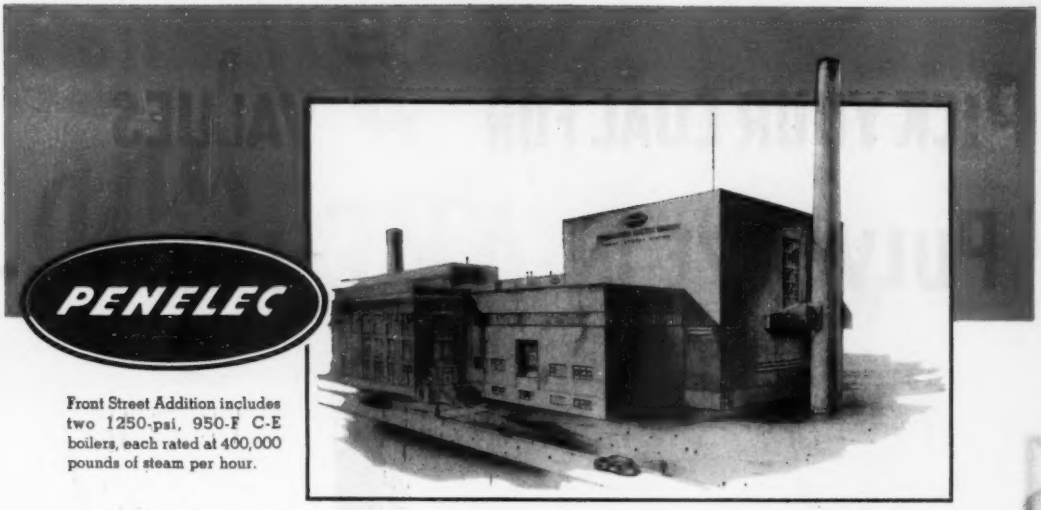
PENNSYLVANIA ELECTRIC COMPANY places 6th order



The COPES Balanced Flow Control, shown here by schematic drawing, takes its control influences from steam flow, feed water flow and water level. Plant personnel can handle all maintenance easily; no need for "experts." The feed valve will stand up under *unlimited* pressure drops.

COPES

BOILER FEED



Front Street Addition includes two 1250-psi, 950-F C-E boilers, each rated at 400,000 pounds of steam per hour.

for COPES MULTI-ELEMENT REGULATORS

COPES Balanced Flow Control will be used for the 1952 addition to Front Street Station of Pennsylvania Electric Company at Erie, Pa. This is the sixth time Penelec has ordered COPES Multi-Element Feed Water Control.

First installation was on the two original 675-psi boilers at Front Street, using two-element COPES Flowmatics. Two later orders placed Flowmatics on four 675-psi boilers at Seward. Two other orders equipped the four 875-psi boilers at Warren with COPES Flowmatics.

Now, for the Front Street Extension, Penelec has selected the COPES Balanced Flow—with control influenced by steam flow, feed flow and water level. This three-influence control is entirely independent of all other instruments and controls, and can remain on fully-automatic when they are out of service for routine inspection and care.

COPES Multi-Element Control is designed for the most modern boilers—for the most difficult operating conditions. Ask for proof of performance.

NORTHERN EQUIPMENT DIVISION

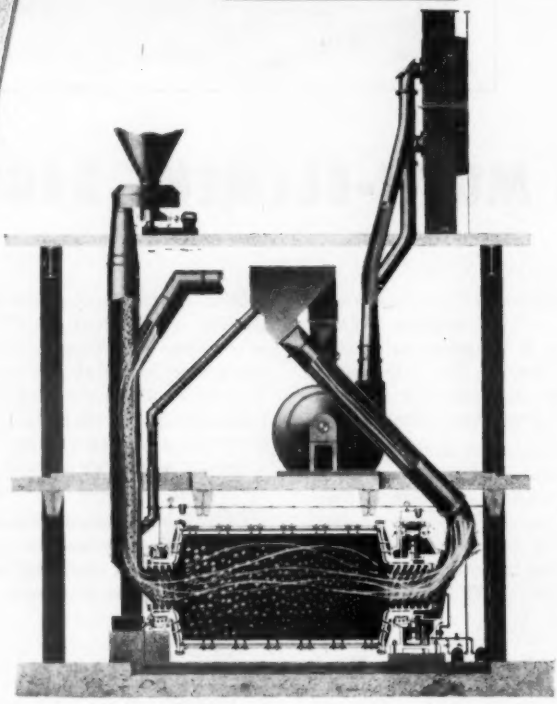
CONTINENTAL FOUNDRY & MACHINE COMPANY

511 Grove Drive, Erie, Pennsylvania

Headquarters for **Feed Water Regulators, Pump Governors, Differential Valves, Liquid Level Controls, Alarms, Reducing Valves, Desuperheaters**

WATER REGULATION

PICK YOUR COAL FOR $ VALUES
PULVERIZE IN KVS MILLS.....



Send for a copy of Engineering Bulletin No. 44-B containing valuable information on the preparation of pulverized fuel and steam generation.

. . . and be assured maximum efficiency and economy in Steam Generation

AS far as coal is concerned, KVS AIR SWEPT TUBE MILLS will completely carburate *all* grades for combustion in shortest possible time.

This ability to pulverize *any* coal quickly to an impalpable powder . . . (85% through 200 mesh) . . . means that great flexibility in coal selection is provided when pulverizing is handled in KVS Mills. Furthermore, it means that coal specifications can be written to permit selecting the best fuel value from available coals to obtain lowest overall cost of steam and highest dollar efficiency. With no limitations placed on it, coal selection becomes a very simple matter.

All other components of KVS Steam Generating Units are engineered to meet specific operating conditions to assure high operating efficiency and maximum economy at all boiler ratings.

KVS is equipped to design and build complete power plants from "bunker to bus bar" in any part of the World and assume full responsibility for overall performance guarantees of all equipment whether or not built in KVS shops.

Kennedy-Van Saun

MANUFACTURING AND ENGINEERING CORPORATION

2 PARK AVENUE • NEW YORK 16, N. Y.

FACTORIES: DANVILLE, PA.

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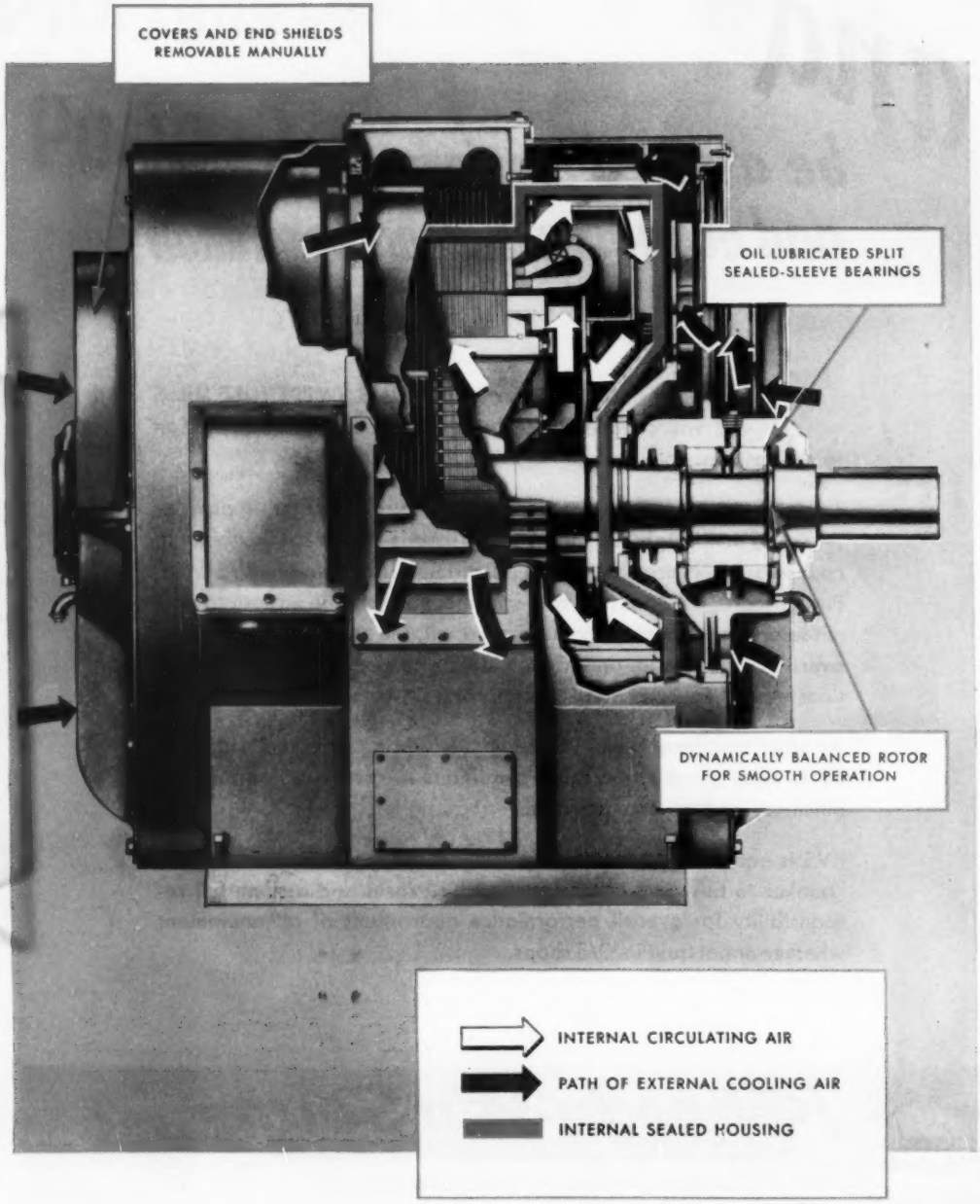
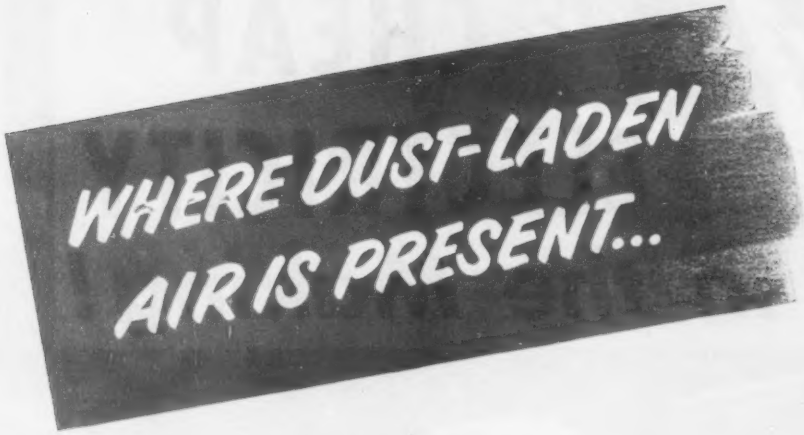

COVERS AND END SHIELDS
REMOVABLE MANUALLY
OIL LUBRICATED SPLIT
SEALED-SLEEVE BEARINGS
DYNAMICALLY BALANCED ROTOR
FOR SMOOTH OPERATION
INTERNAL CIRCULATING AIR
PATH OF EXTERNAL COOLING AIR
INTERNAL SEALED HOUSING



This armed motor wards off crippling attacks

You've got a tough motor application problem where the locale is subject to dust-laden air. It takes equipment that has adequate protection.

Here's a motor that combats the destructive attacks of such elements . . . whose design and materials combine to keep out foreign elements.

Rotor and stator windings are completely enclosed on this Westinghouse Totally-enclosed, Fan-cooled Motor. External air is confined to the outer cooling chamber—no way for it to get in to gnaw away at the vital electrical components. Bearings are sealed in also. Seals keep oil in—foreign matter out.

Further protection is provided by the fabricated steel frame and covers. All steel frame surfaces are protected by several coats of special corrosion-resistant paint. Bonderization anchors this paint and keeps it from cracking or chipping.

Where atmospheres are severe it pays to get the protection of this totally-enclosed, fan-cooled motor. Call your Westinghouse representative today and ask him for the complete story. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-10355

YOU CAN BE SURE... IF IT'S
Westinghouse

LARGE INDUCTION
MOTORS and CONTROLS

More CHEAP ELECTRICITY In the Making!

Three "Buffalo" Forced Draft Fans being installed in a large power station. Note handy inspection and servicing door in housing.

"Buffalo" MECHANICAL

More "Buffalo" DRAFT FANS In More Power Plants!

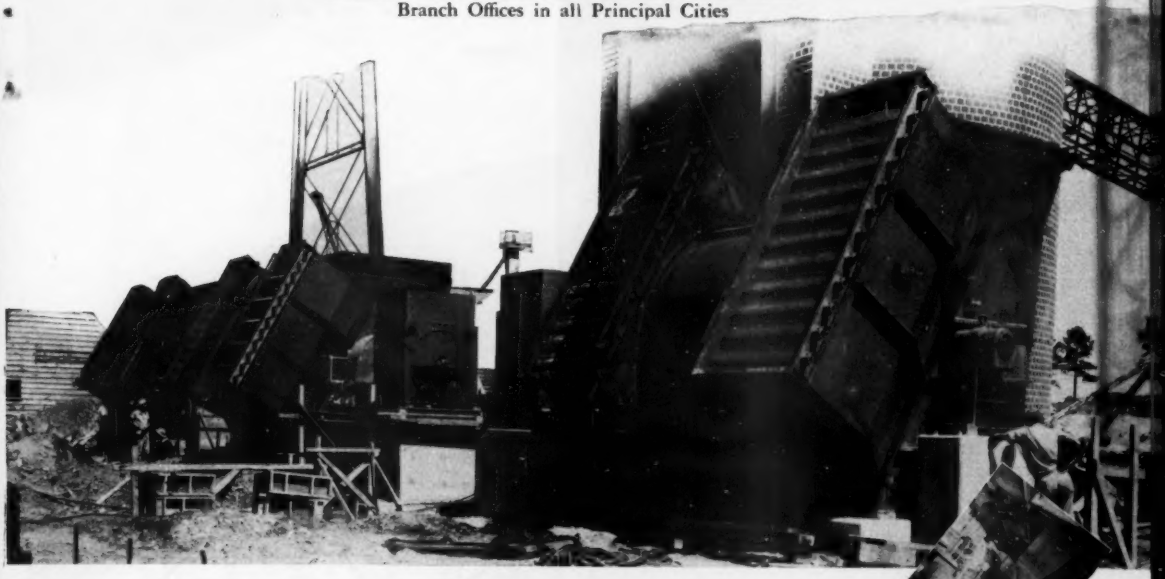
Back of cheap power is efficient, dependable draft. The less time out for repairs and the more efficient the fans, the cheaper the final cost of power production. "Buffalo", pioneer manufacturer of mechanical draft fans, has always built them with these ends in view. The 3 Induced Draft Fans below, being installed in a large power station, illustrate the point. Housings are heavy plate with removable scroll liners to withstand fly-ash erosion for maximum time . . . yet their sectional bolted construction facilitates ultimate repairs. Note the large water-cooled bearings. Para-flow dampers on 45-deg. inlets and up-blast outlets are a recent "Buffalo" development for accurate draft control. For best results, be sure "Buffalo" Draft Fans are in your plans for cheaper power . . . power you can depend on.

BUFFALO FORGE COMPANY

488 BROADWAY BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Branch Offices in all Principal Cities



WRITE FOR YOUR COPY of BULLETIN 3750 for helpful facts on POWER DRAFT.

DRAFT FANS

WHEN LOAD FLUCTUATIONS

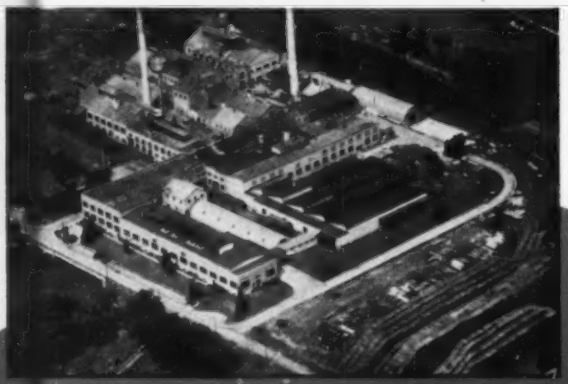
ARE SUDDEN AND VIOLENT...

at THILMANY PULP & PAPER COMPANY

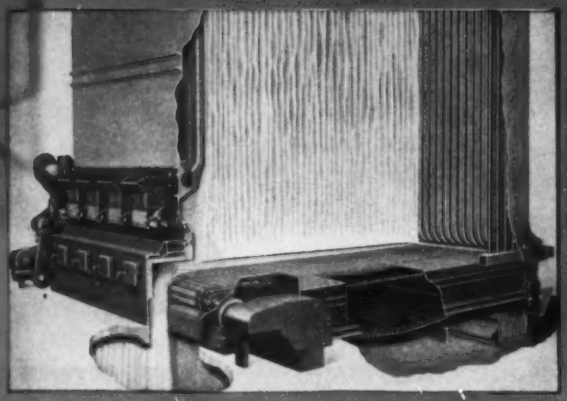
KAUKAUNA • • • WISCONSIN

This is typical Detroit RotoGrate performance. Steam loads on this unit vary in a few minutes from a rate of 30,000 pounds per hour to 120,000 pounds.

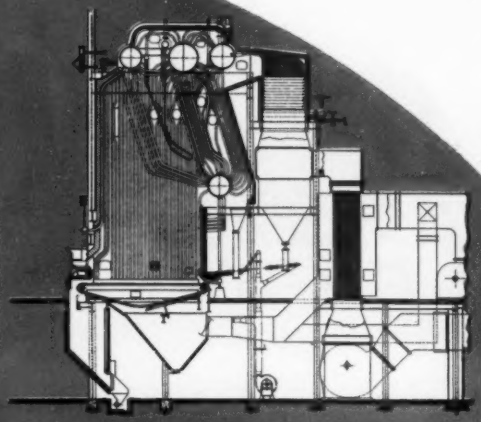
Practically uniform pressure is maintained—amazing flexibility.



The trend is toward RotoGrates which cut the cost of producing steam.



Detroit RotoGrate Stoker with six grate sections as applied to a typical water cooled furnace of a steam generator. Two of the six rotors are removed to show the unique overlapping grate design.



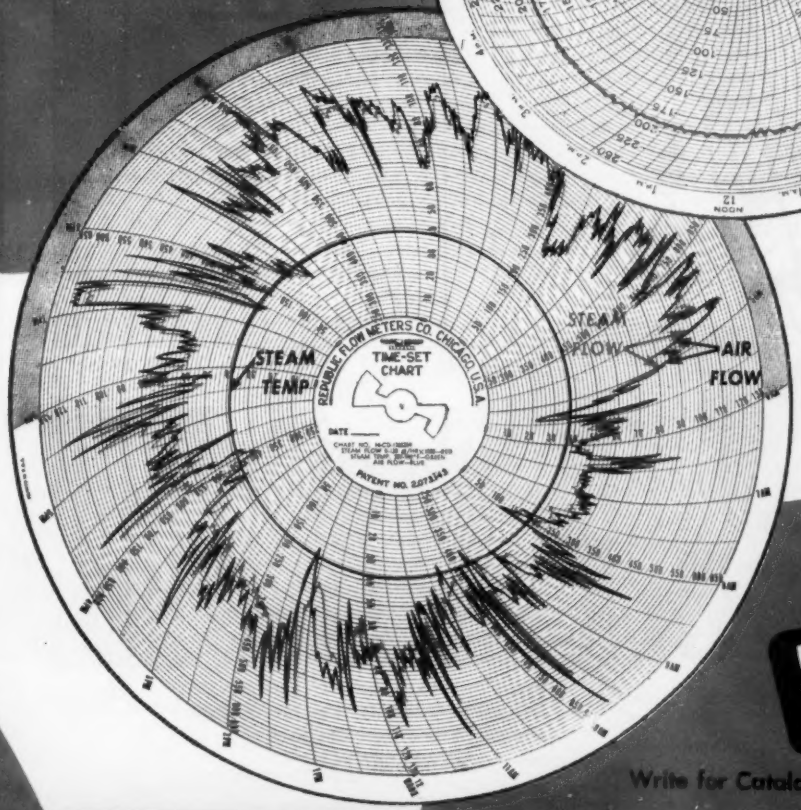
Detroit RotoGrate Stoker applied to a four drum unit having a water cooled furnace, air heater and economizer at Thilmany. Detroit RotoGrate is an advanced design of spreader stoker with forward moving grates that discharge the ash at the front.

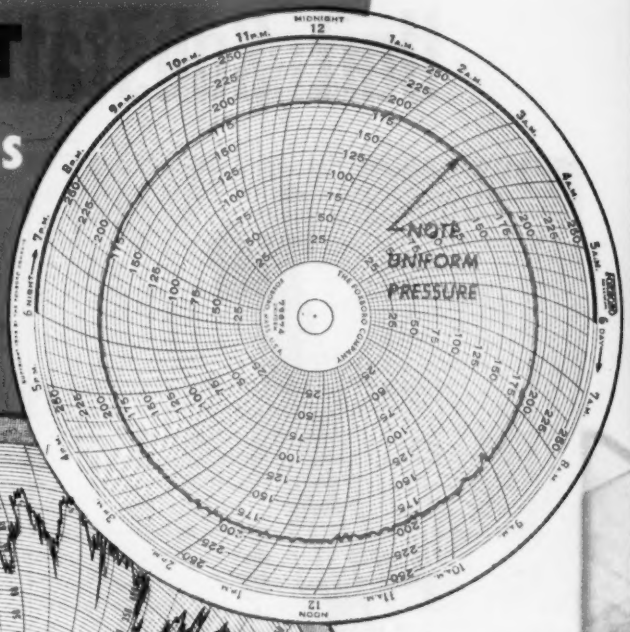
DETROIT

ROTOGRATE STOKERS

keep pressure

UNIFORM





Typical Steam Flow-Air Flow and Steam Temperature Charts under normal operation at Thilmany, show rapid load fluctuations from rates of 30,000 to 120,000 pounds with a sustained load of approximately 100,000 to 110,000 pounds per hour.

DETROIT SINCE 1898 STOKERS

Write for Catalog . . . No obligation.

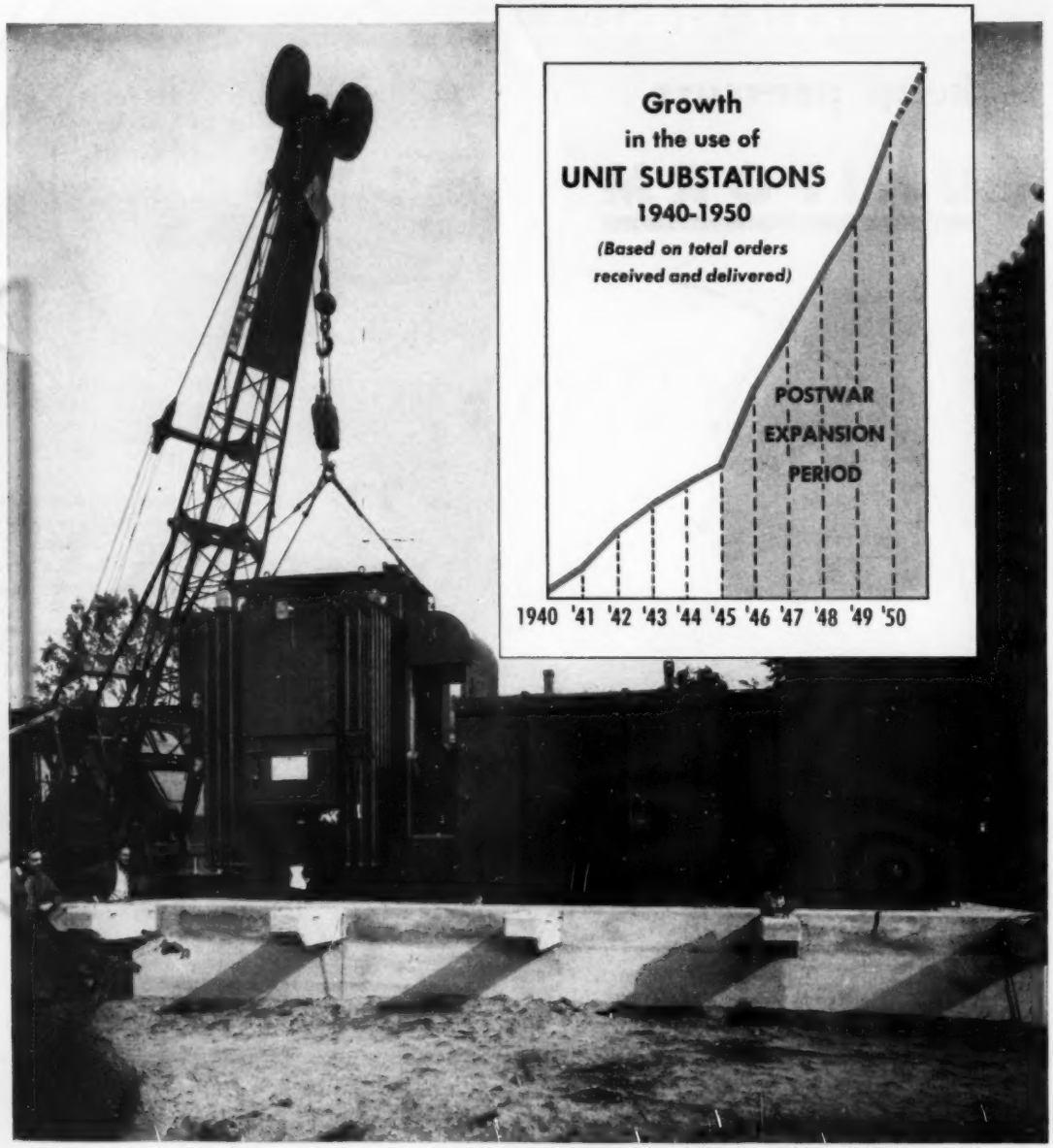
DETROIT STOKER COMPANY

GENERAL MOTORS BUILDING · DETROIT 2, MICHIGAN

Works at Monroe, Michigan . . . District Offices in Principal Cities

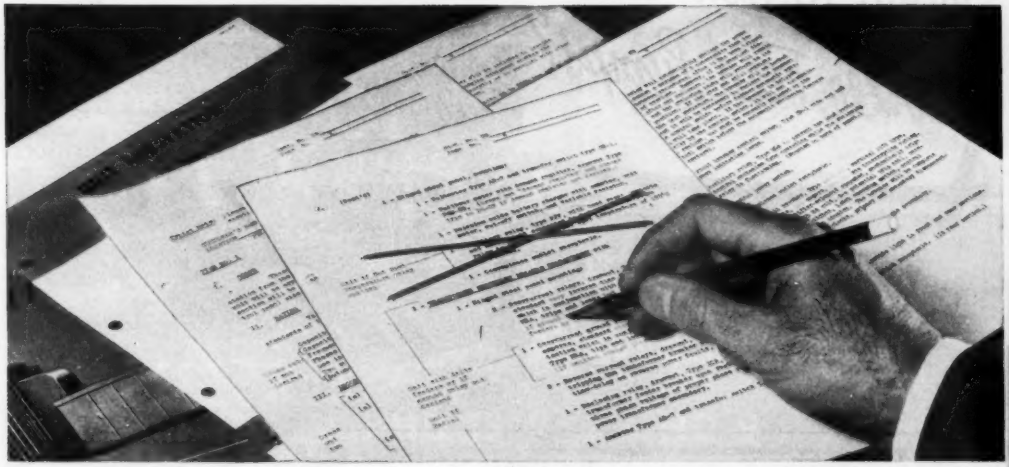
OTHER TYPES AND SIZES OF DETROIT STOKERS FOR EVERY INDUSTRIAL OR POWER NEED

Unit Substations—Key to



QUICK INSTALLATION: G-E unit substations come to you complete—ready for operation. You merely build the foundations, position the equipment and connect to your incoming and outgoing lines. Photo shows G-E unit substation being installed on the system of the Western Massachusetts Electric Co.

Fast, Low-cost Expansion



Simplified purchasing, ease of installation help in meeting fast-growing loads . . .

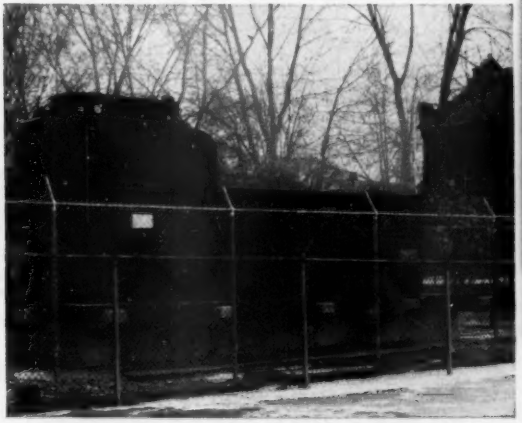
The rapid trend to factory-assembled unit substations—as shown in the chart at the left—seems sure to accelerate even more tomorrow.

Faced with the fastest-growing loads in history, utilities are finding these standardized, easy-to-install units one of their most valued tools in meeting expanding power demands quickly and at lowest cost.

Because of their great flexibility, compactness and adaptability, G-E unit substations are applicable to a wide variety of system arrangements. Standard, co-ordinated designs simplify planning and purchasing.

There's less worry about manpower and material problems. And proved, factory-engineered construction assures outstanding dependability. For full information, write for Bulletins GEA-3800 and GEA-4500. *General Electric Co., Schenectady 5, N. Y.*

WEEKS SAVED IN ORDERING! Basic guide-form specifications for G-E unit substations are available to you, and using these, you merely add ratings and number of circuits required and cross out details not applicable. Weeks are saved in detailing layouts and piecemeal ordering. Your engineers have more time for other system work.

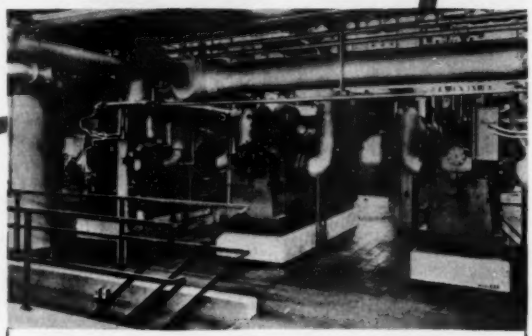


INSTALLED RIGHT AT LOAD: Compact, modern, attractive design of G-E unit substation enables it to be installed close to the load, even in many residential areas. Vital copper for secondary circuits is saved. The substation above was installed by the Western Massachusetts Electric Co. Note church in background.

331-74

GENERAL ELECTRIC

What Metals Are Best For Centrifugal Boiler Feed Pumps?

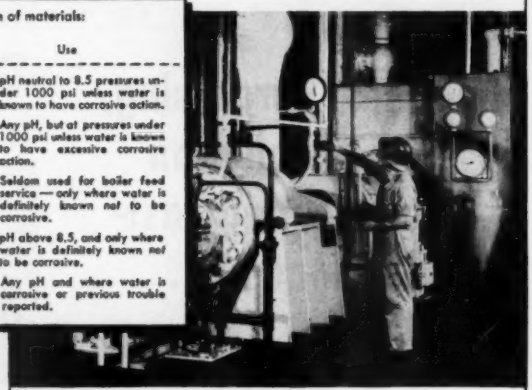


Three Worthington Axially Split Centrifugal Boiler Feed Pumps At The Kansas Power And Light Company Plant, Hutchinson, Kansas.

Drawing on their long experience in the field of hydraulics, Worthington engineers produce boiler feed pumps that are metallurgically correct in design, meeting every requirement as to temperature, pressure and corrosion-erosion resistance. As a result, Worthington boiler feed pumps perform better and last longer.

The following table represents Worthington's recommendation of materials:

Casing	Fittings	Maximum Temperature	Use
1. Cast Iron	Bronze	250 F	pH neutral to 8.5 pressures under 1000 psi unless water is known to have corrosive action.
2. Cast Iron	13% Chromium Stainless Steel	350 F	Any pH, but at pressures under 1000 psi unless water is known to have excessive corrosive action.
3. Carbon Steel	Bronze	250 F	Seldom used for boiler feed service — only where water is definitely known *not* to be corrosive.
4. Carbon Steel	13% Chromium Stainless Steel	400 F	pH above 8.5, and only where water is definitely known *not* to be corrosive.
5. 5% or higher Chromium Steel	13% Chromium Stainless Steel	Any temperature normally encountered	Any pH and where water is corrosive or previous trouble reported.



One of Several Solid Barrel, Radially Split, High Pressure Boiler Feed Pumps at the Trenton Channel Station of the Detroit Edison Co.

This proven selection of materials coupled with the most advanced design, superior workmanship and a thorough knowledge of application show why . . .

THERE'S A *RIGHT* WORTHINGTON PUMP FOR YOU

. . . *right* for the pressure and temperature of your boiler feed service . . . *right* for maximum economy and dependability. For further proof that *there's more worth in Worthington*, contact our nearest District Office, or write to *Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, N. J.*

MEMBER

WORTHINGTON

C1.2

THE WORLD'S BROADEST LINE ASSURES YOU THE RIGHT PUMP FOR EVERY JOB

For Boiler Feed Service
Capacities to 1500 GPM
Heads to 1000 Ft.
For Hotwell, Condensate, Chilled Water Service
Capacities to 1400 GPM
Heads to 650 Feet
For Boiler Feed Service
Capacities to 1500 GPM
Heads to 1600 Feet
For Water Works, Circulation, Drainage, General Service
Capacities to 135,000 GPM
Heads to 400 Feet
For Boiler Feed Service
Capacities to 1600 GPM
Heads to 3500 Feet
For Boiler Feed Service
Capacities to 3000 GPM
Heads to 7000 Feet

ALLIS-CHALMERS
Sets New Standards

Designed For The Job
Built To "Take It"
Easy To Operate
Easy To Service

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model **HD-20**
Hydraulic Torque Converter Drive
175 net engine hp.
41,800 lb.

model **HD-15**
102 drawbar hp.
27,500 lb.

model **HD-9**
70 drawbar hp.
18,500 lb.

model **HD-5**
40.26 drawbar hp
11,250 lb.

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See these tractors perform. They're built for YOUR job!

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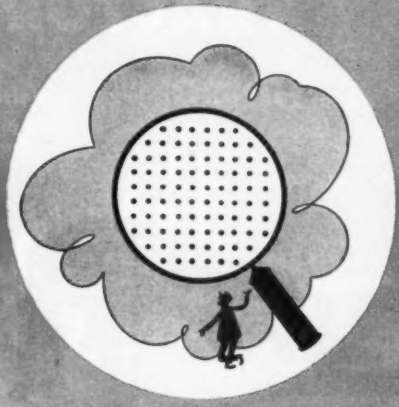
Originator of the Torque Converter Tractor

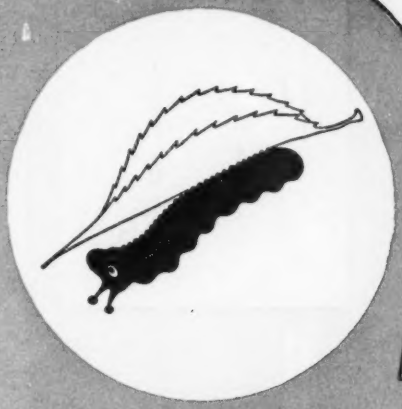
Whatever you need in a Steam Cylinder Oil...

Quick ATOMIZATION



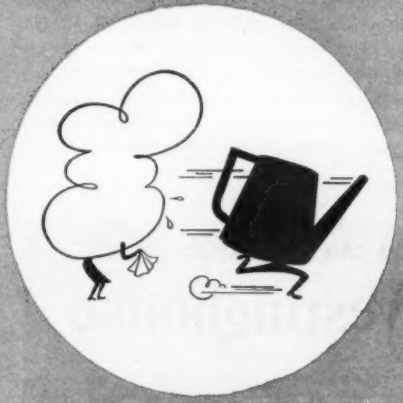
DISTRIBUTION throughout the steam

HIGH TEMPERATURE resistance



ADHESION to cylinder walls and valves

RESISTANCE to washing off lubricated surfaces



Complete SEPARATION from condensate

Sinclair has it!

No matter what your operating conditions—
pressure, temperature, quality of steam; speed, loading;
condensing or non-condensing—
there is a Sinclair Steam Cylinder Oil made expressly
to give the utmost in lubrication satisfaction.

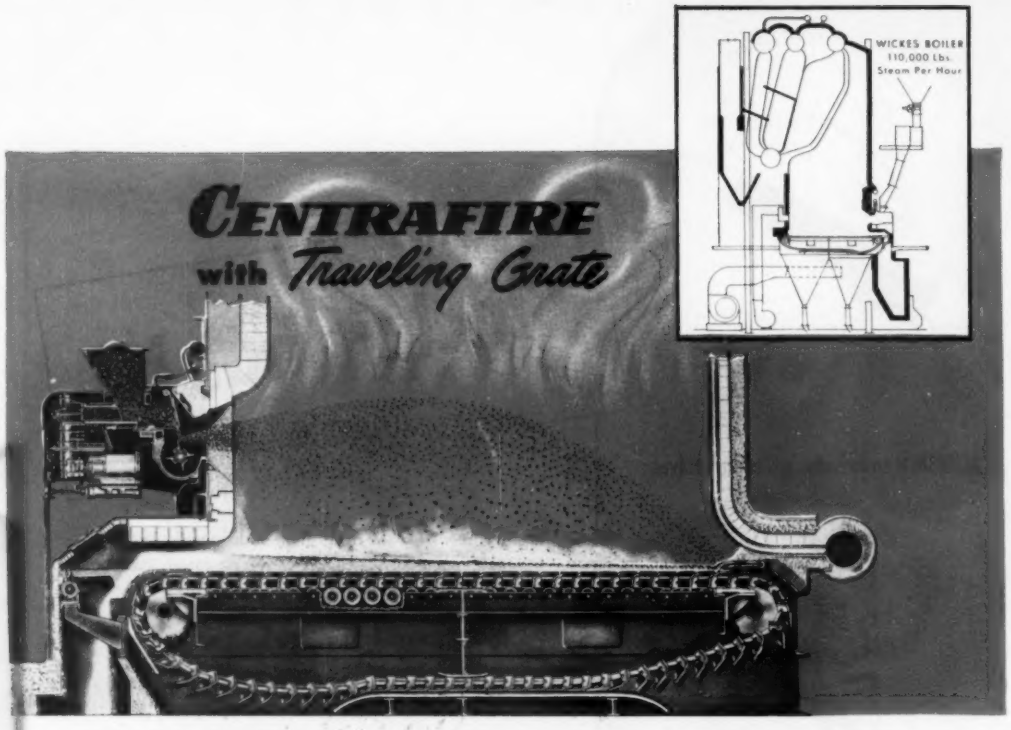
Through proper combinations of steam cylinder stocks and compounding ingredients, Sinclair lubrication technologists have developed a series of steam cylinder oils to fit the operating needs of any installation. There are oils that provide quick atomization . . . persistent adhesion to cylinder walls in the presence of moisture . . . rugged, wear-resisting lubricating films under super-heat . . . or complete separation from condensate where that is the dominating requirement.

A Sinclair lubrication engineer will help you select the proper oil for your particular service.

SINCLAIR
Steam Cylinder Oils

for every steam engine installation

For lubrication counsel see your nearest Supplier of Sinclair Products or write Sinclair Refining Company, 630 Fifth Avenue, New York 20, N. Y.



....brings Extra Engineering Refinements to Spreader-Type Firing

The outstanding performance of the Centrafire® with Traveling Grate stems from features that are built in —not added as accessories.

A positive, metered flow of coal, wet or dry, is fed continuously by an air-cooled overthrow rotor into the combustion area. Proper distribution is effected automatically by cyclic control of the rotor speed.

All moving elements are hydraulically operated by one turbine—or motor-driven oil pump. This assures infinite flexibility through the complete range of operation—synchronizes coal feed and grate speed.

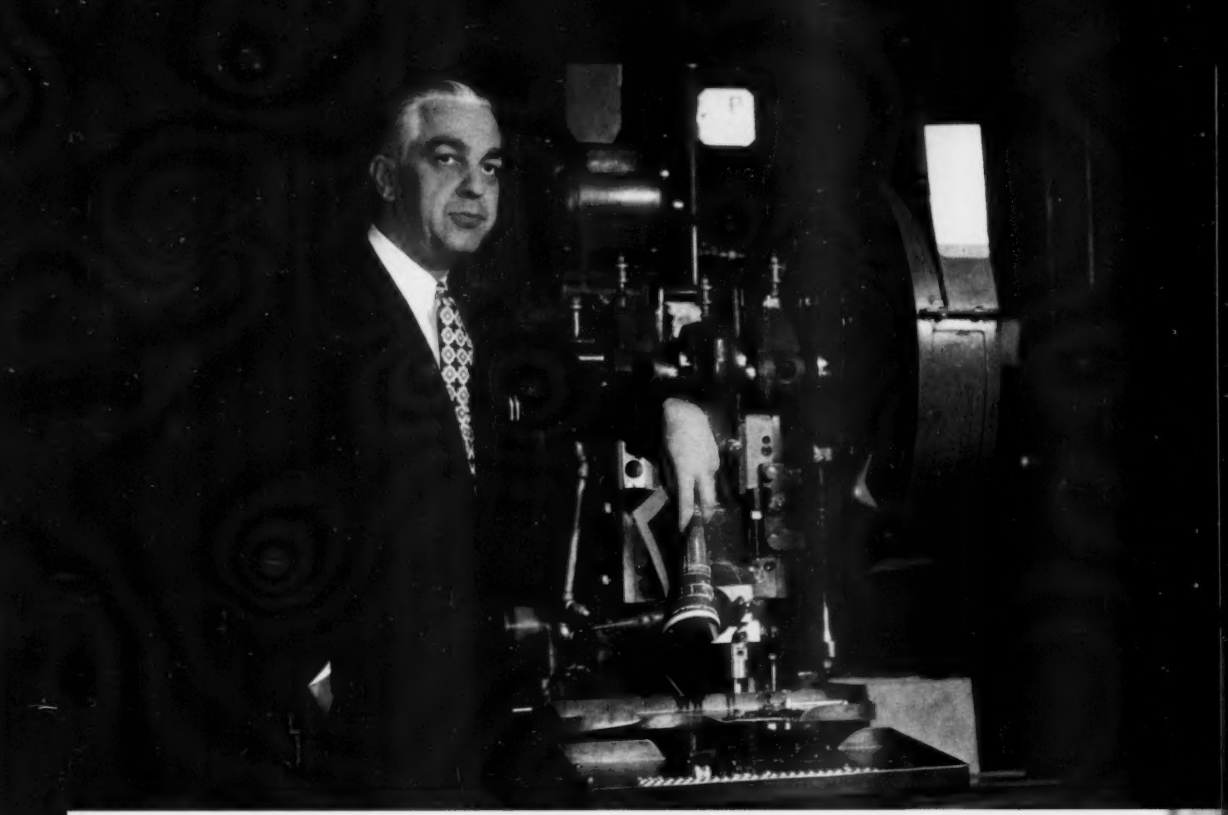
Grates are plate-type, laboratory tested under conditions far more severe than those of actual service conditions. Roller-supported grate chains reduce friction and power requirements.

Fuel distribution adjusted automatically to air flow through front and rear grate sections results in intimate mixing of fuel and air for thorough combustion.

The Centrafire's range extends upward of 300,000 lbs. of steam per hour. Its adaptability to deep, narrow furnaces permits use of the most economical boilers.

Ask your Westinghouse representative for complete data, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-50522

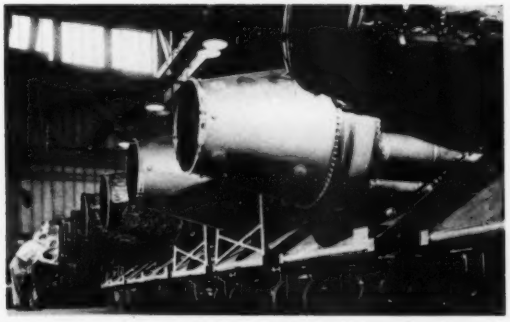
YOU CAN BE SURE.. IF IT'S
Westinghouse
STOKERS



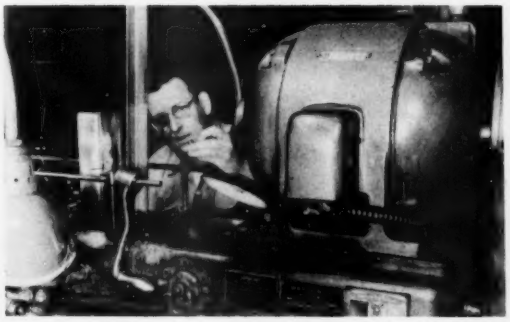
FRED A. HOFMANN, production vice president of the Elastic Stop Nut Corporation of America, says, "We're back on a full 2-shift production schedule, and practically every one of the 62 Tri-Clad motors we've installed since 1941 in our plant at Union, N. J., is going night and day. Sure, we make a lot of steel products But for a general-purpose motor, we don't think you can beat cast iron. After the pounding we've given our Tri-Clad motors for the past 10 years, we're stronger than ever for Tri-Clads."

ELASTIC STOP NUT CORPORATION:

"We're stronger than ever for Tri-Clad triple protection!"

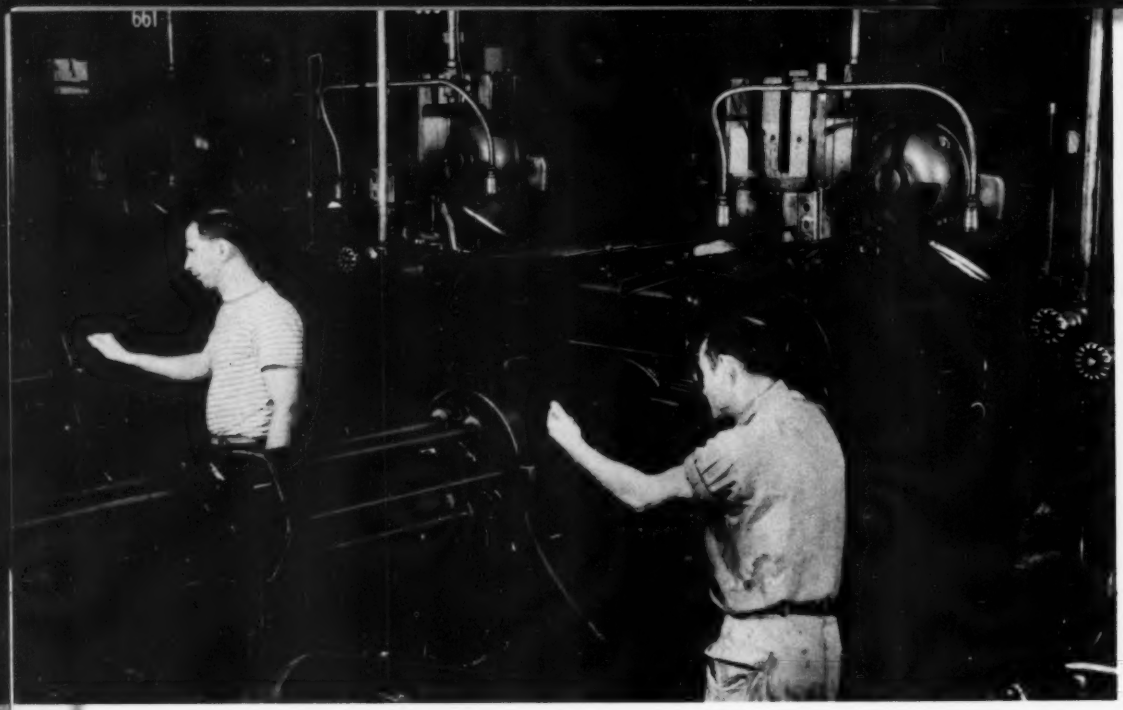


TRI-CLAD MOTORS drive machines that produce ESNA fasteners for use on jet aircraft engines—the engines that power our modern military planes. Each of the jet engines above uses a large number of these special stainless-steel high-temperature nuts, designed to hold under the extreme heat and other severe conditions of jet-engine operation. Moreover, these nuts must be re-usable without seizing or galling the finish. ESNA counts on the reliability of their Tri-Clads to help turn out thousands of these fasteners every day.



VIRILE VETERAN. This 10-hp Tri-Clad motor has been driving an Acme Gridley multiple spindle bar machine for nearly 10 years. It's still going strong, another reason why, after 10 years, ESNA thinks Tri-Clad is still their best motor buy! And today's Tri-Clad motor, all-industry favorite, is better than ever!

GENERAL ELECTRIC



4 STEPS—AND NO HANDS! Backbone of the ESNA production line, the Acme Gridley automatic bar machine (3 shown above) ejects a finished nut blank every 4½ seconds. The operator simply keeps the six spindles supplied with bar stock. The machine feeds stock, machines the nut profile, drills 2 holes and cuts off to accurate lengths. The load on the 10-hp drive motor is heavy and constant—but Tri-Clad, with its bearings completely enclosed in cast-iron housings, can take it! Maintenance department can't recall a single Tri-Clad bearing ever having to be replaced. Moreover, if they need it, the motors are easily geared while running.

GE

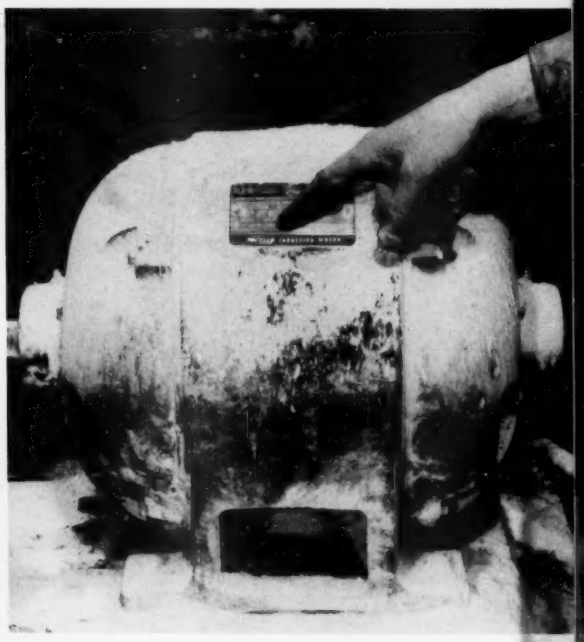
TRI CLAD MOTORS

REG. U.S. PAT. OFF.

Help Keep ESNA Production Up!

PRODUCTION PUSHER General plant foreman Karl Kjellburg has the job of meeting "impossible" defense program manufacturing schedules. He's counting heavily on automatically fed machines like the Tri-Clad driven V. & O. press on his left, says, "This press inserts over 200 elastic fibre locking collars a minute in a ⅜" fastener. Driving it is a big job for a motor. Our Tri-Clads gave us no trouble during the war. We're counting on them again!"

TROUBLE SHOOTER TESTIFIES Ed Conk, ESNA's maintenance chief, must furnish reliable power wherever it's needed in the plant. He's got some definite ideas about electric motors; says, "We like a motor you can regrease easily *if you have to.* So far, we've had to regrease very few of our Tri-Clad motors. And those were either on hot spots or on particularly tough jobs. The point is—we *could* readily have regreased them all if it was necessary."



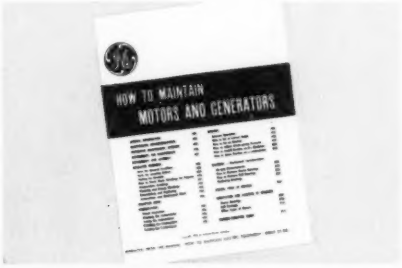
TOUGHEST... on the inside Extra protection against electrical breakdown is built into every Tri-Clad motor. Formex* wire windings, one-piece cast-aluminum rotor, double-end ventilation—these are features that prolong a general purpose motor's useful life.

TOUGHEST... on the outside Teeth rattling blows, dripping liquids, corrosive fumes—they're all in a day's work for Tri-Clad cast-iron construction. You get a rigid structure, too—one that won't twist out of line when you're bolting it down.

TOUGHEST... at the bearings A Tri-Clad motor will run safely without relubrication for as long as any general purpose motor you can buy. But, if the application does make relubrication a "must", you can grease your Tri-Clad without halting production.

** Reg. U.S. Pat. Off.*

How to Keep Your Motors in Shape for the Job Ahead!



TIMELY READING With every electric motor needed on the line, once again it's time to be a crank about motor care. That's why every motor user needs this General Electric manual. Tells how to spot motor and generator trouble before it happens, how to prevent serious breakdown, how to conduct a regular motor maintenance program. Order a copy for your maintenance department today! Use the coupon!

General Electric Company
Section 732-8
Schenectady 5, New York

Please send me my free copy of "How To Maintain Motors and Generators" (GET-1202)

Name_____

Company_____

Address_____

City_____ **State**_____

GENERAL ELECTRIC

Turn the page for the latest news on motor selection and application. ➡

NEED HELP IN TRAINING MANPOWER?

Here's a Valuable Tool! —G-E's New Course on

MOTOR SELECTION AND APPLICATION

9 Slide Films and Accompanying Manuals To Help You Get the Most Out of Electric Motors

Timed to help meet the growing demand for skilled industrial workers, this new General Electric Motor Selection and Application Course is a boon to everyone concerned with technical training problems. Here, in 9 short, easily understood lessons, is a "how-to" course that offers a broad introduction and review of motor principles and uses to engineers, plant personnel, students and all others concerned with motors. *It's a valuable production-boosting tool for any type plant!* Ask your G-E representative for more details on this course or mail the coupon today.

HERE'S WHAT THIS COURSE CONSISTS OF:

9 Sound slide films and records. 9 Sets of Review Booklets (10 per set) for student use. 1 Instructor's Manual—(This 96-page manual is virtually a complete course in itself.) Complete kit—Slide films, Review Booklets, and Instructor's Manual, in sturdy carrying case—**$100.00.**

Here's a Quick Look at the Scope of the Course

Lesson 1—"Fundamentals of Motors"—Basic principles of motor operation, how a-c and d-c motors work, construction features, etc.

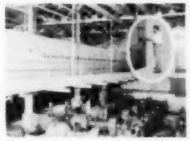
Lesson 2—"Types of Motors"—Horsepower, speed and torque and other characteristics, ranges of application, design features.

Lesson 3—"Fundamentals of Selection"—A study of the five basic steps that are usually followed in the selecting of any motor.

Lesson 4—"A-C Polyphase Induction Motors"—Characteristics of the three basic types: squirrel-cage, wound-rotor, adjustable-speed induction.

Lesson 5—"Single-Phase Integral-HP Motors"—General range of applications, torque and safety factor, capacitor and repulsion-induction types.

Lesson 6—"D-C Motors"—Basic types: shunt, series, compound; horsepower formulas, adjustable speed applications, versatility, etc.



Lesson 7—"Synchronous Motors"—Where used, design features, power factor improvement, and other basic operating benefits.

Lesson 8—"Adjustable-speed Drives"—Speed range and versatility of various packaged adjustable-speed drives, typical applications.

Lesson 9—"Gear Motors"—Selection and application of the three classes of gear units. Advantages of these low-speed drives.

MAIL THE COUPON TODAY!

(Attach this coupon to your business letterhead and mail Today)

General Electric Company
Section 684-20
Schenectady 5, N. Y.

Gentlemen:

Your Motor Selection and Application Course sounds like it may be valuable in our training program.

☐ Send me a complimentary copy of the Course Manual, GEZ-310, for my inspection, at no cost to me.

☐ Send us a complete course for a 10-day free trial. If we do not return the course at the end of the trial period, you are to bill us $100.00 for this complete course.

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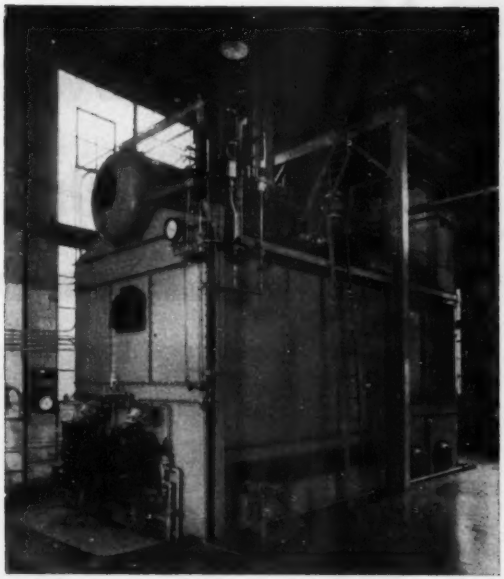
GENERAL ELECTRIC

684-20

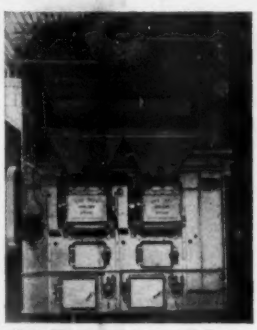
A LOW HEADROOM BOILER

That can take it

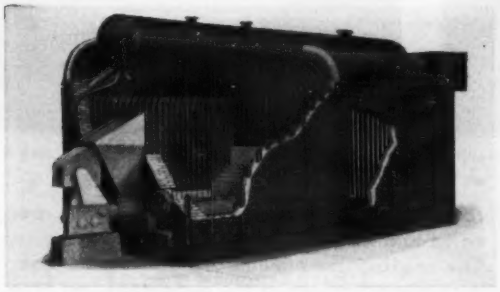
THIS compact, low headroom 2 drum water tube boiler features extra large water and steam capacity. Side wall water cooling reduces refractory maintenance to the vanishing point even at maximum ratings. As illustrated here the VL is well adapted to all firing methods. The VL's all steel casing and trim appearance makes any boiler room a showroom. It is recommended for sizes to 750 HP and is furnished as a completely shop assembled unit in sizes to 300 HP and larger depending upon railroad clearances.



250 HP Erie City VL-Boiler oil fired at a western New York dry cleaning plant.



160 HP Erie City VL-Boiler fired by Erie City Spreader Stoker in an Ohio automobile manufacturing plant.



Outstanding of many VL features is the ring-flow circulation in each side wall element. A downcomer tube for each pair of radiant (riser) tubes in the side wall with auxiliary front wall downcomers assure an ample supply of clean circulating water in the walls at all times. Tile between riser and downcomer tubes assures rapid and unrestricted circulation.

200 HP Erie City VL-Boiler fired by Erie City Underfeed Stoker in a western paper products plant.

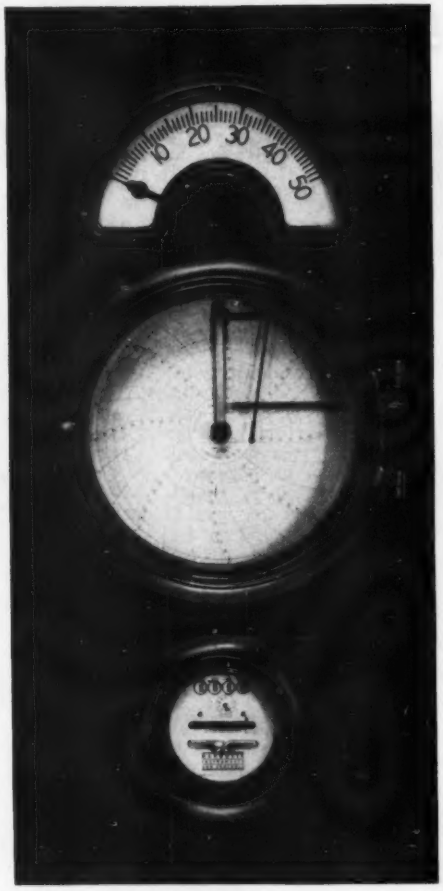
FOR COMPLETE DATA
***write for* BULLETIN SB24B**

COMPLETE STEAM POWER PLANT EQUIPMENT

ERIE CITY

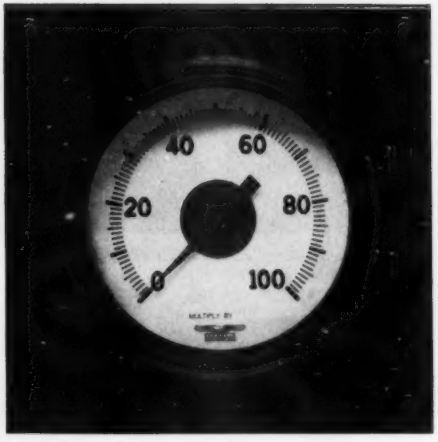
Complete Steam Generators • Type C 3-Drum Boilers • Types VL & VC 2-Drum Boilers • "Economic" Boiler with or without Water Walls • Welded H. R. T. Boilers • Welded Steel Heating Boilers • "Keystone" Packaged Steam Generators • Coal Pulverizers • Underfeed and Spreader Stokers • Welded Pressure Vessels for the Process Industries.

ERIE CITY IRON WORKS • ERIE, PA. • *Since 1840*



Indicator-Recorder-Integrator

Varying flows because the



Indicator

The Republic flow integrator, being of the modified watt-hour type, totalizes continuously —not intermittently. It operates independently of the recorder and its accuracy is not dependent on or affected by any clock mechanism or mechanical action.

The Republic meter is, on this account, peculiarly fitted to follow all changes in flow rate and accurately measure highly fluctuating flows.

ALL TYPES OF FLUIDS

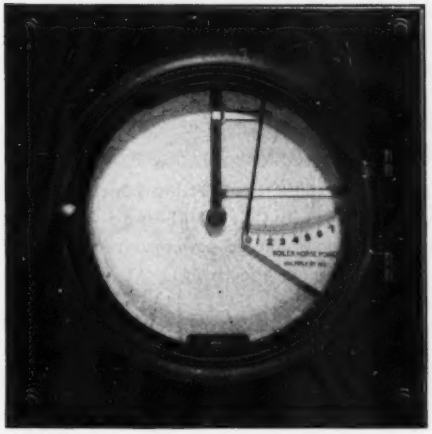
Republic electric type flow meters are available for measuring the flow of all types of liquids and gases. Meter bodies are built for metering fluids at line pressures up to 5,000 lb. per sq. in. and for all ranges of differential pressure. The reading instruments — indicator, recorder and integrator—are of the remote reading type and can be located any distance from the point of flow measurement.

ANY COMBINATION

While each Republic reading instrument is standard in design and construction each is especially calibrated for the particular flow measurement for which it is specified. Any reading instrument, indicator, recorder or integrator, may be obtained separately or in any

are accurately totalized

integrator is continuous



Recorder

Integrator

combination desired, making possible the highest degree of flexibility in plant use.

SIMPLE IN OPERATION

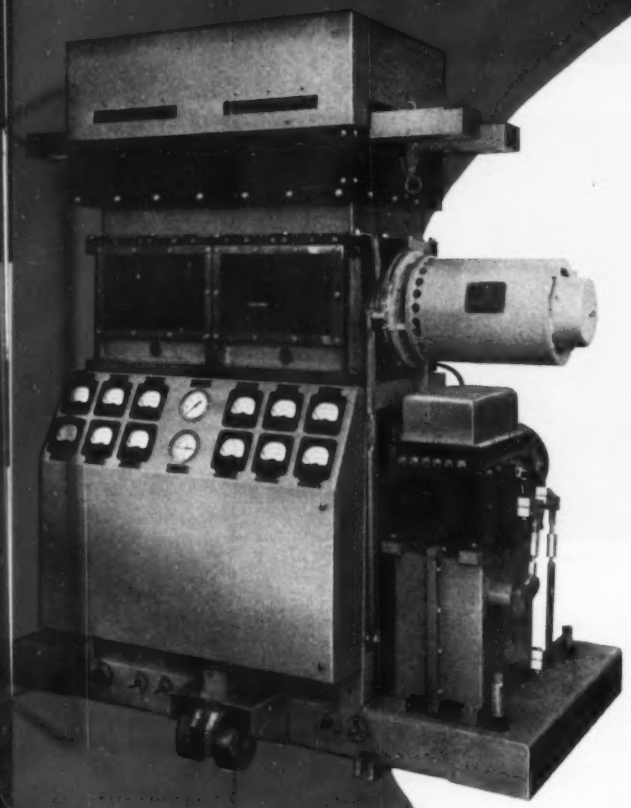
The Republic electric meter is the only flow meter commercially manufactured which is strictly electric in its operation. All other types of so called electric meters use the motion of the mercury to move a float or produce a force which is then converted into an electrical value which is in turn transmitted to a receiving or reading instrument. In the Republic meter, the transmitted electrical value is determined directly by the mercury motion, thus eliminating one of the steps in the sequence, and simplifying the mechanism to that extent. Their are no floats, levers, cams, rotating shafts or anything else to interfere with the unimpeded movement of the mercury, which has no work to perform, but merely fulfills the function of making contact.

NEW DATA BOOK

Just off the press—a completely new data book describing and illustrating, in detail, the operating features of the Republic Flow Meter and its many applications. Write for your copy of Data Book No. 702—there is no obligation.

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

SEVEN I-T-E MECHANICAL RECTIFIERS



The heart of the I-T-E Mechanical Rectifier — one 10,000 ampere contact mechanism with contacts enclosed in box on top. Driving eccentric can be seen through windows. At right is the drive motor, with automatic regulator below. The 12 indicating instruments show the timing of each contact while the mechanism is running and carrying load.

I-T-E Mechanical Rectifiers are available in the following ratings: 1,000—3,500—5,000—7,000—8,000—9,000—and 10,000 amperes, in any voltage from 50 to 400 volts d.c. Primary voltages 2,300 to 46,000 three-phase a.c.

Two years ago, Buffalo Electro-Chemical Company, Inc., Buffalo, N. Y., installed two I-T-E Mechanical Rectifiers, the first mechanical rectification units ever built in this country.

This pioneering spirit of Buffalo Electro-Chemical's progressive management justified itself to the extent that at present I-T-E has orders for five more Mechanical Rectifiers—to augment Buffalo's current modernization program.

I-T-E's Mechanical Rectifier has benefited Buffalo Electro-Chemical—and can handle your low voltage power conversion requirements more effectively.

1 HIGHER EFFICIENCY—actually 96% or more in the 100 to 400 volt range, because silver to silver contact minimizes voltage drop in rectifying element.

2 SPACE SAVINGS — extremely compact grouping of all operating and protective apparatus.

3 EASY, LOW-COST INSTALLATION—unit assembly at factory allows "packaged" delivery, easy installation. No special structural foundations are required; no crane service is needed in rectifier room.

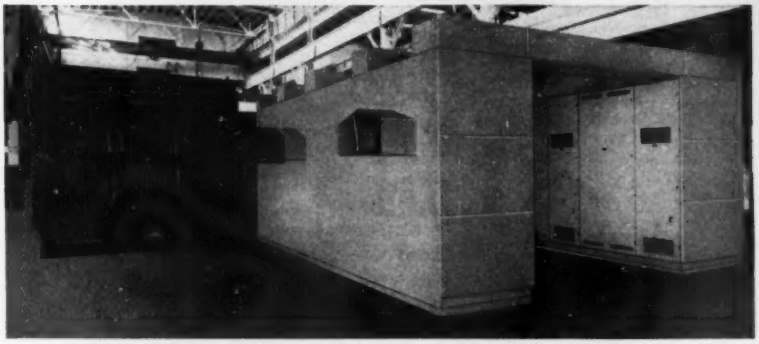
4 SIMPLE, LOW-COST MAINTENANCE—maintenance is almost entirely mechanical, requiring no trained personnel, complicated tools or instruments for servicing.

5 SIMPLE OPERATION—push-button starting without preliminary warm-up of any kind; immediate connection to load.

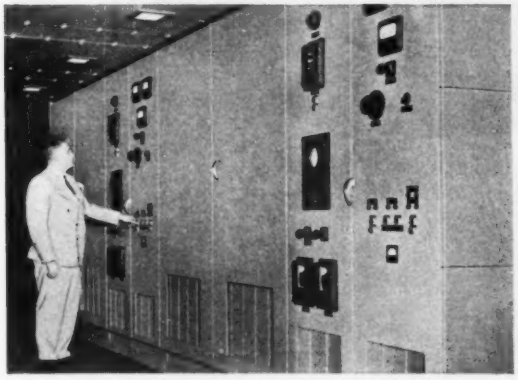
6 SAFETY—use of low voltage in your cell room increases safety to operating personnel and equipment.

FOR BUFFALO ELECTRO-CHEMICAL

TYPICAL I-T-E MECHANICAL RECTIFIER ARRANGEMENTS



Factory assembly of two 10,000 ampere units with outdoor transformer (only one of two shown), throat connection through wall rectifier enclosure, operating aisle and d-c switchgear compartments.



Close-up of control and instrument panel. The thoroughness of I-T-E engineering is illustrated by the overhead lights, furnished with the installation and assuring proper illumination of the control panel.

View looking through operating aisle, rectifier enclosure and control panel to left, d-c switchgear to right, interconnecting d-c bus overhead.

I-T-E

R&IE

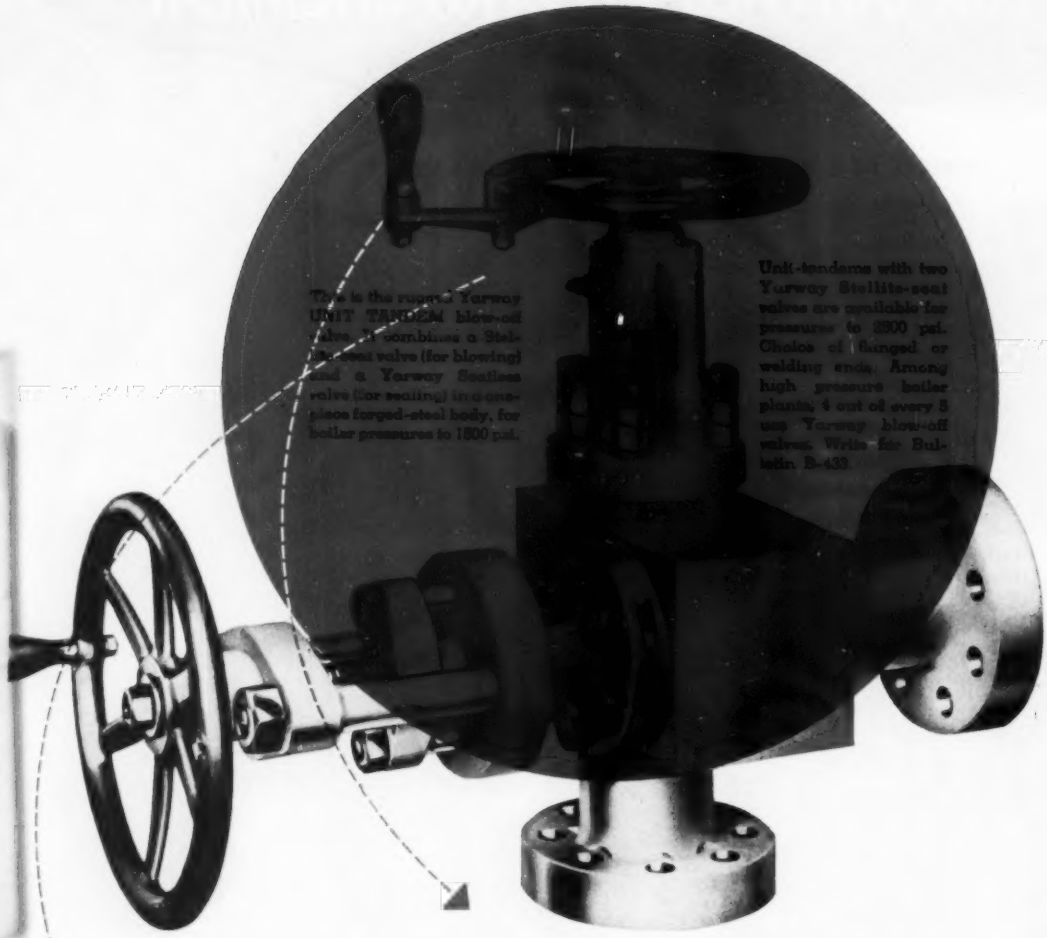
MECHANICAL RECTIFIERS

I-T-E Circuit Breaker Company, 19th and Hamilton Streets, Philadelphia 30, Pa.

Power Equipment · Railway and Industrial Engineering Co., Greensburg, Pa.

Canadian Mfr. & Sales: Canadian Power Apparatus, Ltd., Toronto · Export Sales: Philips Export Corp., New York

MECHANICAL RECTIFIERS · SWITCHGEAR · AIR CIRCUIT BREAKERS · OIL CIRCUIT BREAKERS · SWITCHBOARDS · METERING · SPECIAL EQUIPMENT



Unit-tandems with two Yarway Stellite-seat valves are available for pressures to 2500 psi. Choice of flanged or welding ends. Among high pressure boiler plants, 4 out of every 5 use Yarway blow-off valves. Write for Bulletin B-433.

Dependable Yarway Blow-Off Valves

STOP a lot of

boiler blow-down troubles...

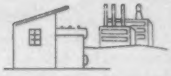
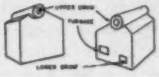
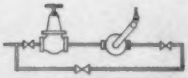
... and keep production schedules on the **GO** by avoiding costly power shutdowns

Famous Yarway Sentinel Tandem blow-off valve, with balanced sliding plunger design. Type "P" (shown) is for pressures to 400 psi. Available in all combinations of angle and straight-type valves. More than 15,000 boiler-plants of all pressures use Yarway blow-off valves. Write for Bulletin B-421.

YARWAY **BLOW-OFF VALVES**

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

Combined features that distinguish Foster Wheeler package steam generators

WATER TUBE DESIGN	Vertical tubes,...steady water level, closely spaced waterwall tubes on 3½" centers
FACTORY ASSEMBLED STEAM PLANT	Compact, self-contained steam generating units
WIDE RANGE OF CAPACITIES	7,500 to 30,000 lb per hr . . . flexible multi-unit installations for greater capacities
HIGH STEAM TEMPERATURES	Provisions for superheaters in some designs
PORTABILITY	May be transported by common carrier . . . minimizes problems of initial installation and plant relocation
EXPERIENCE	50 years' design, engineering, manufacturing of power plant equipment behind each Foster Wheeler unit
EASILY INSTALLED	Simple foundations . . . few service connections
OUTDOOR INSTALLATION	Rugged, steel encased construction 
ACCESSIBILITY	For inspection,...cleaning, maintenance 
COMBUSTION CONTROLS	Fully or semi-automatic controls for single or multi-unit installations
CONTROL VALVES	Equipped with 3-valve by-passes 
CLEAN HEATING SURFACES	Soot blowers incorporated . . . cleaning without boiler shutdown
HEAT LOSS MINIMIZED	Minimum heat loss—from radiation and air infiltration
RAPID LOAD SWINGS	Large diameter drums and ample furnace heating surface

all for the

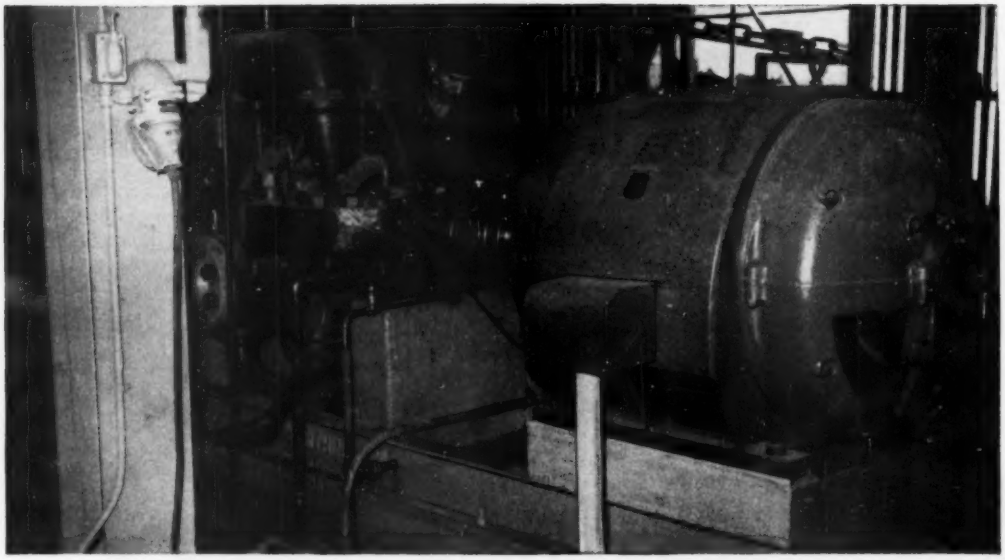
price of a PACKAGE

Your operation deserves a *real* steam plant. Today, mounting orders from large and small companies alike testify to the fact that Foster Wheeler Package Steam Generators are supplying industry's answer to the need for a compact, highly efficient source of steam. These units assure economy in the cost of steam production and high availability. They are easily installed and adapted to various fuel and firing arrangements. The Foster Wheeler Package Steam Generator presents a relatively inexpensive way to modernize your plant.

FOSTER WHEELER

For further information, write FOSTER WHEELER CORPORATION • 165 BROADWAY, NEW YORK 6, N. Y.

35 Starts a Week!



J. B. Wilt, Manager of Spaulding Pulp and Paper Company of Newburg, Oregon, says: "We have found our 500 hp E-M Induction Motor equal to every demand placed upon it. It has been entirely satisfactory in performance and has handled capably the frequent starts to which it is normally subjected."

Spaulding's E-M 2-Pole Induction Motor WITHSTANDS SEVERE STARTING DUTY

What do you expect from high-speed motors? At Spaulding Pulp and Paper Company they expect plenty . . . and get it. Their 500 hp, E-M Heavy-Duty 2-Pole Induction Motor is making an average of *35 starts a week* driving a hydraulic barker pump. This is a grueling test of good 2-pole motor construction . . . the powerful magnetic forces due to starting current inrush put a tremendous strain on the motor.

Tough starting is not the only difficult service. E-M motors can be built with the extra capacity needed to withstand unusual load conditions, high ambient temperatures, high peak loads, or special atmospheric conditions which it may encounter.

Day-in, day-out, this 3580 rpm motor at Spaulding is giving smooth, cool running service. This barker pump motor is an example of exacting pump, blower, and compressor duty, on which E-M motors give top performance. And this is the kind of service E-M can give *you*—Contact your nearest E-M Field Engineer for details—he's an experienced Engineer who can give you competent advice and application information on all types of drives.

ELECTRIC MACHINERY MFG. COMPANY • MINNEAPOLIS 13, MINNESOTA

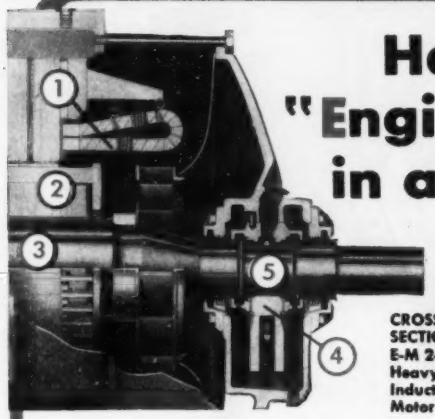
E-M

Specialists in
BIG MOTOR ENGINEERING

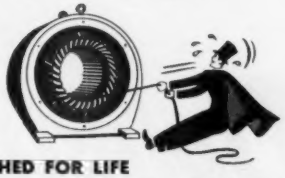
E-M engineers are working for YOU!

● At E-M, competent, experienced engineers individually job design heavy-duty motors to fit *your* requirements. What we call "*Engineering Magic*" is actually nearly 50 years of specialized experience, plus the will to build into your motor every feature of skilled engineering that promotes top performance. You'll see below some of the extra value features that make E-M high-speed Induction Motors your *best* buy.

Here's "Engineering Magic" in action:

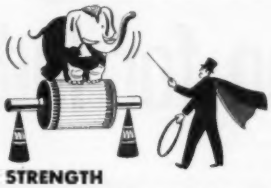


CROSS-SECTION of E-M 2-pole, Heavy Duty Induction Motor



1 LASHED FOR LIFE

You can have full voltage starts with no coil distortion!! Lashing formula fits the individual job. High strength, neoprene treated spun glass lashing cord used exclusively. "Power house" external coil protection keeps moisture *out!*



2 BRUTE STRENGTH

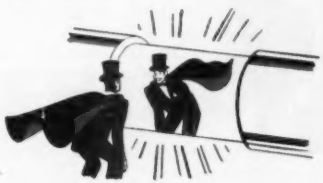
You're assured of adequate power for your job. Oxygen-free copper bars and deep penetration welding gives extra-strong cage. The torque that is built into the rotor will last for the life of the motor.

3 PRECISION BALANCE

You can count on a smooth running motor. The magic of electronics in the "Dynetric" balancing machine achieves a rotor balance exceeding all commercial standards.

4 UNYIELDING BABBITT BOND

You're insured against bearing deterioration due to babbitt fatigue. The magic of electrolytic etching of the shell and centrifugal casting of babbitt gives a permanent bond as strong as the metal itself.



5 MIRROR SUPERFINISH

You get ultra-smooth, cool running bearings. "Harmonic motion" superfinishing hones the journals to a mirror surface.

ELECTRIC MACHINERY MFG. COMPANY, Minneapolis 13, Minn.

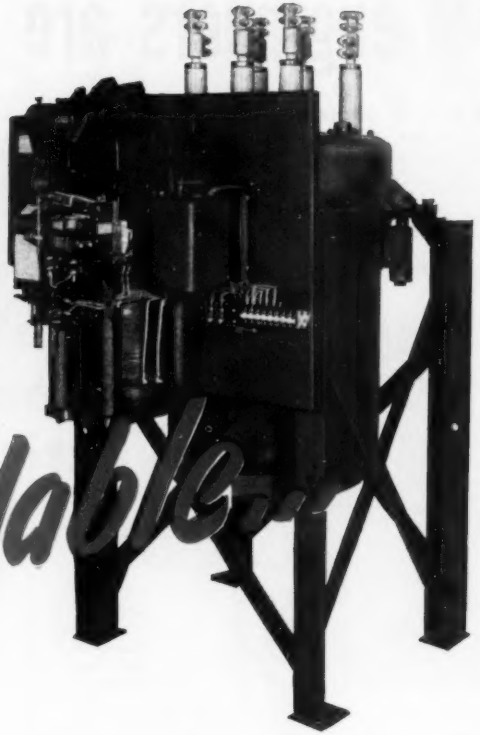
1300-TPA-2097

ALLIS-CHALMERS

TYPE DZ-LARGE INDOOR

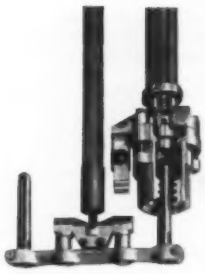
INDUSTRIAL

Oil Circuit Breakers



Dependable...

Electrical Protection for Industry



YOU CAN GET full electrical protection for equipment in your plant with the 8-cycle DZ oil circuit breaker. It is liberally and compactly designed to meet your requirements economically.

Mechanically and electrically trip-free, it combines reliability in operation with the advantages of the single break *Ruptor* interrupting device.

The DZ comes in a wide range of ratings. Mounting with framework or for cubicle, solenoid or manual closing, standard operating voltages, all in accordance with ASA standards.

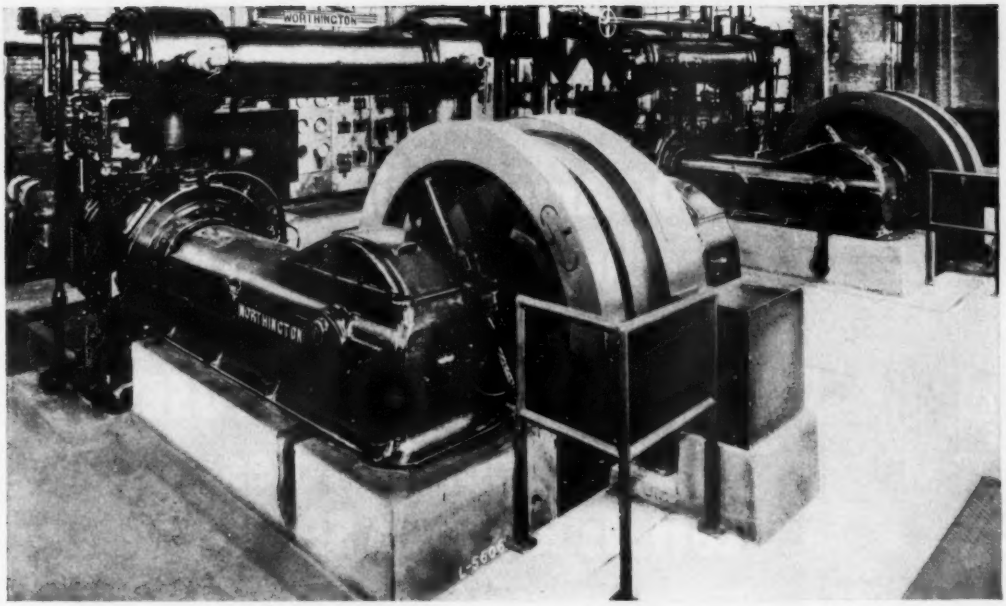
For more information, see your nearby A-C sales office. Or write Allis-Chalmers, Milwaukee 1, Wis. for bulletins 71B6129D (DZ-60B, DZ-100B, DZ-200B) and 7iB6179C. (DZ-40B) A-3381

Ruptor is an Allis-Chalmers trademark.

TYPE	RATED K.V.	MINIMUM KV AT RATED KVA	RATED AMPS.	KVA INT. CAPACITY
DZ-40B	7.2	2.3	600	100,000
			1200	100,000
			2000	100,000
DZ-60B	13.8	4.0	600	150,000
			1200	150,000
DZ-100B	13.8	4.0	1200	250,000
DZ-200B	13.8	6.6	1200	500,000
			2000	500,000

The circuit interrupting efficiency of the *Ruptor* arc interrupting device is the result of simple, yet highly effective contact structure. Its effectiveness is proved over many years of service in these and larger power oil circuit breakers.

ALLIS-CHALMERS



Link-Belt "Hooks Up" with Worthington Air

You can't find a compressed air need that Worthington can't fill.

This installation pictured above is a Worthington DC2 air compressor in Link-Belt Company's Pershing Road plant in Chicago. And that picture could be duplicated all over America where engineering-wise plants insist upon dependable, trouble-free, low-cost air.

One reason is—*only* Worthington makes air compressors with the Feather* Valve. Any other valve is complicated beside this Worthington exclusive. Feather* Valve is the simplest, lightest, most efficient ever made.

Then there's Worthington automatic variable capacity control—acknowledged the most accurate, flexible and simple control obtainable. And Worthington's high-efficiency intercooler that needs less water, less power, less attention.

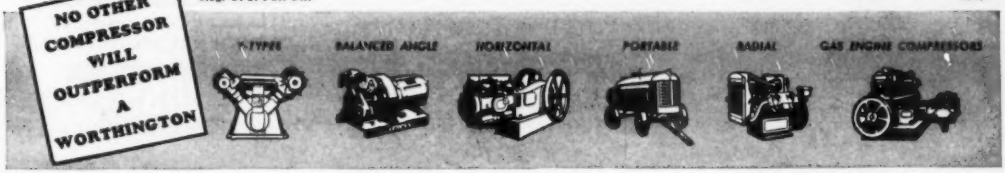
Build around these features with sturdy construction . . . back up the machinery with Worthington application engineering—and you have plenty of reasons for deciding *there's more worth in Worthington*. Worthington makes all auxiliary equipment, too. Write for bulletin L675 B-1B to Worthington Pump and Machinery Corporation, Compressor Division, Buffalo, N. Y.

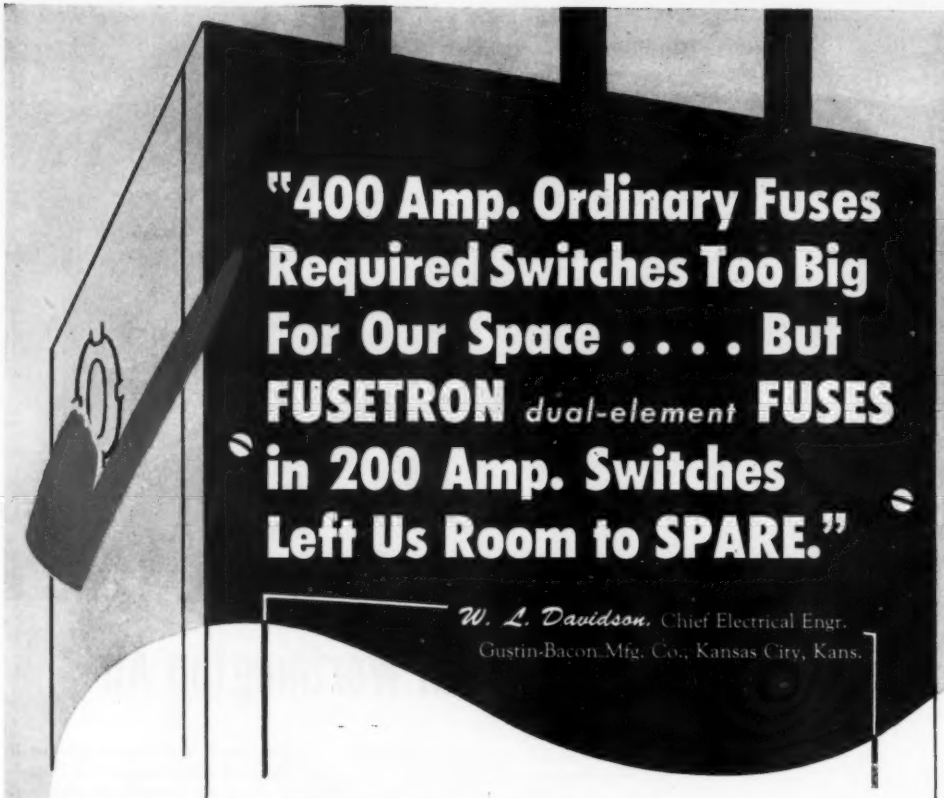
WORTHINGTON

*Reg. U. S. Pat. Off.

K.I.9

NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON





"400 Amp. Ordinary Fuses Required Switches Too Big For Our Space . . . . But FUSETRON *dual-element* FUSES in 200 Amp. Switches Left Us Room to SPARE."

W. L. Davidson, Chief Electrical Engr.
Gustin-Bacon Mfg. Co., Kansas City, Kans.

"When we were revamping five 3 phase 220 volt motor circuits, each feeding a 25 h.p. and a 15 h.p. motor, at our Fairfax plant — we found we were short of room for the 400 amp. main switches required by ordinary fuses.

"By changing to Fusetron dual-element fuses, however, we were able to use 200 amp. switches and have room to spare.

"The installation has proved very satisfactory, and in addition, we get better protection because the motors are fused nearer to the operating load."

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

(FUSETRON is a trade mark of the Bussmann Mfg. Co., Division of McGraw Electric Co.)

You Get 10 Point Protection by changing to

Fusetron DUAL-ELEMENT Fuses

1. * Protect against short-circuits.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating — lesser resistance results in much cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloading.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnout.

*Fusetron Fuses have high interrupting capacity as shown by tests of the Electrical Testing Laboratories of New York City in December 1947.

Here's Why You Get This All-Purpose Protection

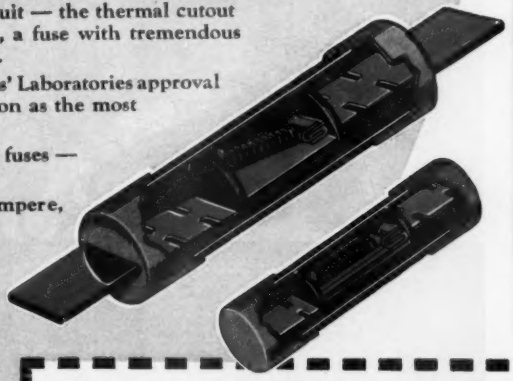
The fuse link element opens on short-circuit — the thermal cutout element protects on overloads — the result, a fuse with tremendous time-lag and much less electrical resistance.

They have the same degree of Underwriters' Laboratories approval for both motor-running and circuit protection as the most expensive devices made.

Made to the same dimensions as ordinary fuses — fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.



Don't Risk Losses!

One **needless** shutdown . . .
One **lost** motor . . .
One **destroyed** switch or panel . . .
One **burned out** solenoid . . .

May cost you far more than replacing every ordinary fuse with a Fusetron dual-element Fuse.

Mail the Coupon Now!

Bussmann Mfg. Co., University at Jefferson
St. Louis 7, Mo. (Division McGraw Electric Co.)

Please send me complete facts about FUSETRON dual-element Fuses.

Name_____

Title_____

Company_____

Address_____

City and Zone_____ State_____ 551

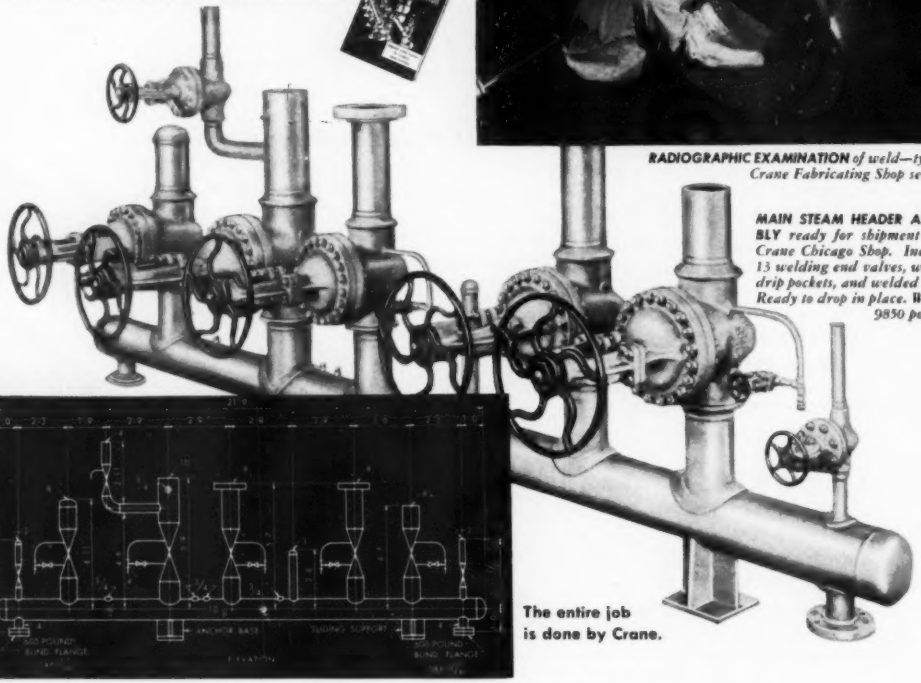
no unit fabrication job too tough for CRANE

Whether your piping project calls for a simple pipe bend . . . or a complex welded assembly . . . Crane fabricating facilities can handle it. No pipe shop is better equipped to do your *entire* job from drawings of *your* design.

At Crane all steps of fabrication—such as bending, welding, stress relieving or heat-treating, radiographic examination, hydrostatic testing—are rigidly checked under procedure control to maintain adequate standards of accuracy and quality.

And because each assembly is tested as a unit, with major assemblies proved in advance of installation—you can erect your piping systems with minimum expense and delay. For further information, **ask for Folder AD-1771.**

RADIOGRAPHIC EXAMINATION *of weld—typical Crane Fabricating Shop service.*



MAIN STEAM HEADER ASSEMBLY *ready for shipment from Crane Chicago Shop. Includes 13 welding end valves, welded drip pockets, and welded bases. Ready to drop in place. Weight 9850 pounds.*

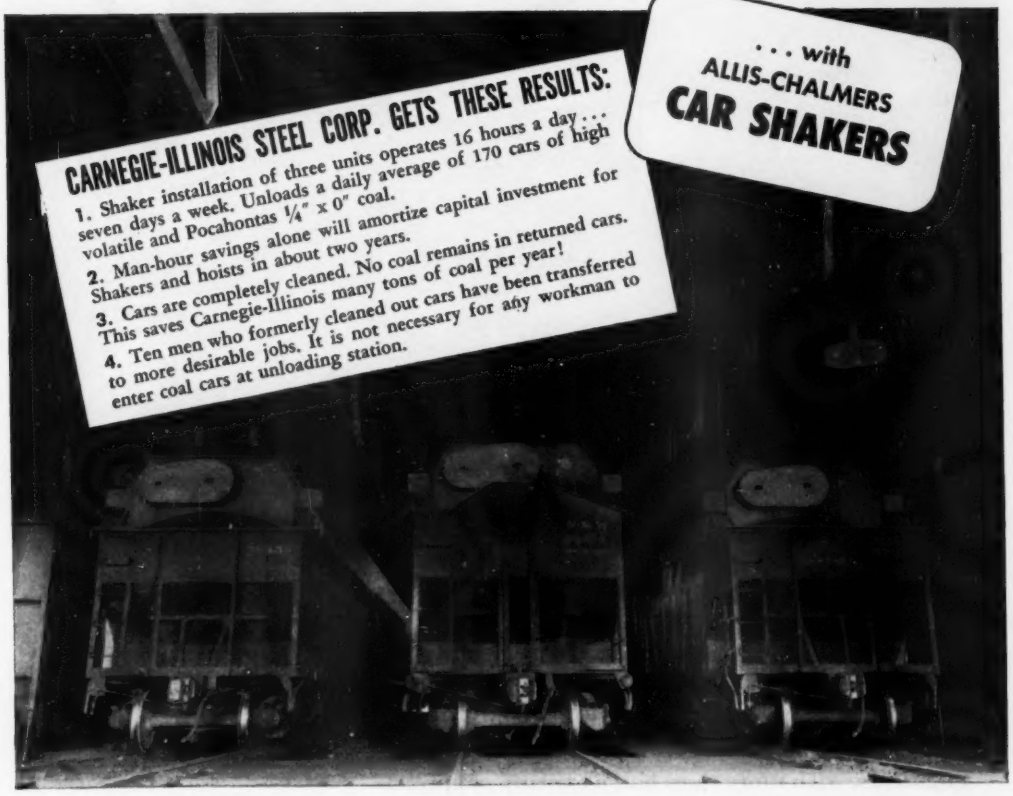
The entire job is done by Crane.

CRANE

CRANE CO., *General Offices:*
836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

STEEL MILL UNLOADS
170 Coal Cars Daily!


CARNEGIE-ILLINOIS STEEL CORP. GETS THESE RESULTS:
1. Shaker installation of three units operates 16 hours a day . . . seven days a week. Unloads a daily average of 170 cars of high volatile and Pocahontas ¼" x 0" coal.
2. Man-hour savings alone will amortize capital investment for Shakers and hoists in about two years.
3. Cars are completely cleaned. No coal remains in returned cars. This saves Carnegie-Illinois many tons of coal per year!
4. Ten men who formerly cleaned out cars have been transferred to more desirable jobs. It is not necessary for any workman to enter coal cars at unloading station.
. . . with
ALLIS-CHALMERS
CAR SHAKERS

YOU CAN GET SIMILAR SAVINGS in demurrage charges and man-hours by installing an Allis-Chalmers Car Shaker. And you save with safety! Accidents are eliminated as workmen do not have to mount the car during the automatic unloading operation.

The Shaker is driven by a 15 hp, high torque, integrally enclosed Allis-Chalmers motor — mounted on rubber to protect motor from severe vibration.

For complete information on how the Car Shaker can help *you* save time and money, contact your nearby A-C Sales Office. Or write for Bulletin 07B7221.

ALLIS-CHALMERS, 952A SO. 70 ST.
MILWAUKEE, WIS.

Please send Car Shaker Bulletin 07B7221.

Name .....

Title .....

Firm .....

Address A-3171

ALLIS-CHALMERS

Coal has to STEP FAST at this power plant

Twenty-five tons of coal per hour—from cars to bunker—is the proved performance of this S-A REDLER installation, requiring very little space and minimum supports. It is typical of the way S-A engineers, with more than half a century of specialized experience to draw upon, solve specific material handling problems. . . . If you have a question on moving bulk materials you will save time and money—and assume no obligation—by talking it over with qualified S-A engineers. Your inquiry is respectfully invited.

ENDICOTT-JOHNSON CORPORATION
Endicott, N. Y.

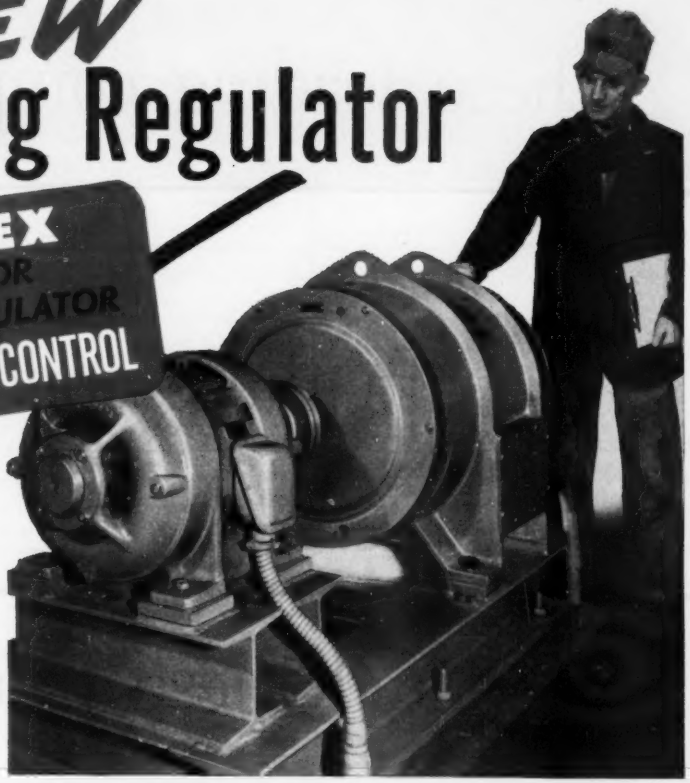
Roof top view shows head end of REDLER elevator transferring coal to a 20-foot long horizontal REDLER conveyor which discharges through four outlet chutes into boiler room bunker located directly below roof. Coal is received in a track hopper, is fed to an S-A KNITTEL ring-type crusher and then delivered to the feed section of the REDLER elevator. Coal placed on yard storage can be reclaimed to a special hopper for re-entry into the REDLER handling system.

1901-1951
50 years experience with bulk handling
STEPHEN S-A ADAMSON MFG. CO.
5 Ridgeway Avenue, Aurora, Illinois · Los Angeles, Calif. · Belleville, Ontario

DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT

NEW Rotating Regulator

REGULEX
GENERATOR
VOLTAGE REGULATOR
POWER PLANT CONTROL



1 Minimizes the effect of disturbances caused by sudden load changes and fault conditions.

2 Controls generator excitation so as to increase safe operating limits.

3 Provides proper division of reactive current between synchronous machines operating in parallel when a cross current compensator is applied.

4 Provides accurate, sensitive voltage control.

5 Functions without hunting.

6 Provides high rate of excitation voltage response to restore voltage to normal as quickly as possible after a disturbance.

7 Provides alternate manual control of excitation without disturbance of the existing excitation.

WHEN SELECTING generator voltage regulators for your power plant, consider these seven big advantages of new *Regulex* control. Remember that *Regulex* control gives you pin-point accuracy while improving service continuity by reducing outages for maintenance. You can use *Regulex* generator voltage regulators on alternators, synchronous condensers and dc generators. Call your A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin for further information.

A-3298

Regulex is an Allis-Chalmers trademark.

ALLIS-CHALMERS

Order Telegraph Systems

The Allis-Chalmers Order Telegraph System is accurate and reliable . . . can be depended upon even during station power failure because it uses the dc bus for its power source. An alarm system operates until the order is returned correctly. Five or ten inch semi-flush dials for switchboard mounting. Use it to transmit orders between switchboard and turbine room.

Automatic Speed Control for Boiler Draft Fans

Draft fans operate at exactly the required speed for perfect combustion when Allis-Chalmers Type 257 Liquid Rheostats are used with wound rotor drive motors. They are application engineered to provide straight line speed characteristics . . . automatic wide range stepless speed control. Use electric, pneumatic or hydraulic pilot devices. Ask for leaflet 14S7544.

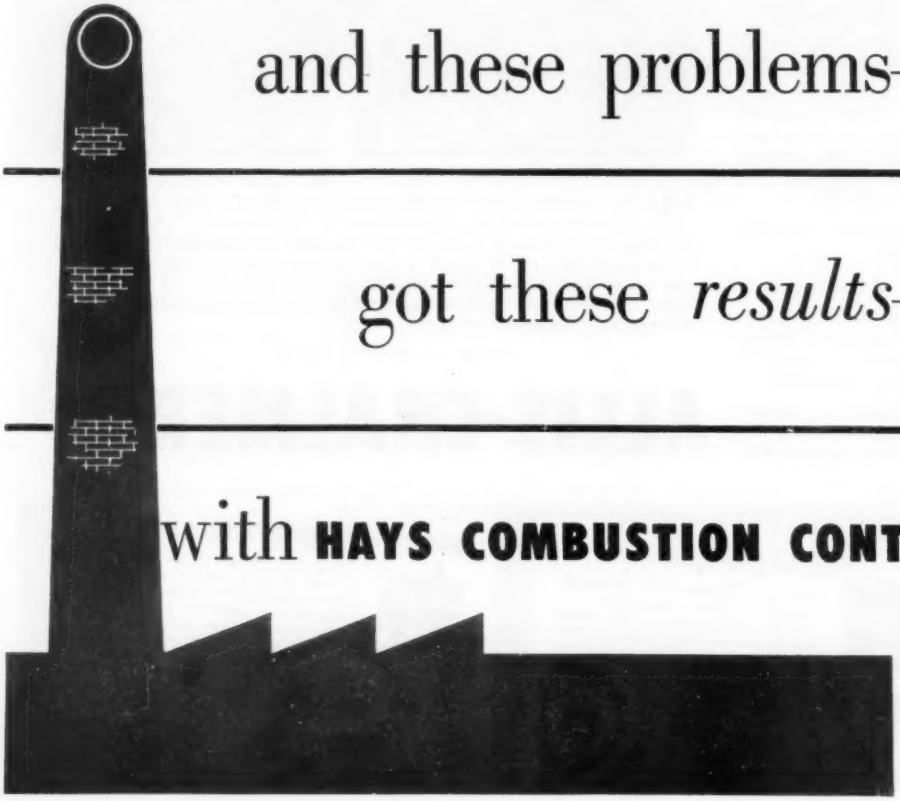
these leading companies →

with these conditions {

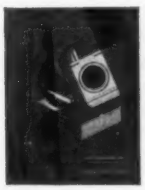
and these problems →

got these *results* →

with **HAYS COMBUSTION CONTROL**



	AMERICAN TOBACCO COMPANY	SHERWIN-WILLIAMS COMPANY	RAYBESTOS-MANHATTAN COMPANY	BEMIS BROS. BAG COMPANY	SUNSHINE BISCUIT COMPANY
no. of boilers	Three (one stand-by)	Three	Four	Two	One, plus steam generator incinerator
rating	16,500 lb per hr	65,000 lb per hr	19,650 lb per hr	70,000 lb per hr and 80,000 lb per hr	31,500 lb per hr
load	Varies from 40-50,000 lb per hr total fluctuation up to 20,000 lb per hr	75,000 max. each boiler	120,000 lb per hr in winter—70,000 lb per hr in summer	68,000 lb per hr in winter, 60,000 lb per hr in summer. Daily variation 15,000 lb per hr	From 10,000 to 30,000 lb per hr
fuel	Coal	Coal	Coal	Oil and coal	Oil
use of steam	Power and process	Process and space heating	Mostly for process, also for pumps, compressors and heating	Power, process and heating	Process
	1. To recondition or add new boiler 2. Better process load regulation	Combustion efficiency	To get better efficiency. To get more out of boilers due to rising load	Accurate control of pulverized coal and oil firing through wide load swings	To lower costs. Drastic load fluctuations
	(1) "The Hays instruments and controls, through greater efficiency . . . gave us the solution . . . that of increasing steam capacity" and (2) "regulating the steam that goes into process."	"Operating efficiency has been as high as 82%—much of the credit going to the accuracy of (Hays) automatically controlled combustion."	"Our basic reason for installing the Hays control was to obtain better efficiencies. Our aim was more than reached . . . efficiency . . . 79.3%."	"We have made test runs using the Hays automatic combustion control system, bringing the load rapidly up from 8,000 lb per hr to 80,000 lb per hr with excellent results."	"Our management and operating crew are well pleased with the new (Hays) unit, not only because of the low maintenance costs but also because the equipment enables us to keep close watch over our operating costs."



compare your control requirements and write for the results story which matches your needs—free on request

THE **HAYS** CORPORATION *MICHIGAN CITY 3, INDIANA* • Automatic Combustion Control • Boiler Panels •

Hays-Penn Flowmeters • Veriflow Meters and Veritrol • Gas Analyzers • Draft Gages • Combustion Test Sets • CO_2 Recorders • Electronic Oxygen Recorders

Eagle-Picher Insulation can help you get maximum heat and power from each fuel dollar expended

Here's insulation that will save you money

EAGLE-PICHER DE-85 BLOCKS

A highly efficient, rigid-type insulating material composed almost entirely of pure, lightweight, Eagle-Picher Diatomaceous Earth. High physical strength enables these blocks to stand up under usage normally encountered in installation. Adaptable to virtually all types of heated equipment. Can be cut with a knife, or sawed, to fit irregular shapes. DE-85 Blocks for temperatures to 1300°F. DE-95 Blocks for temperatures to 2000°F.

EAGLE-PICHER "99" FINISHING CEMENT

Finishing cement for temperatures up to 1000°F. Adheres tightly to hot or cold surfaces with practically no shrinkage. Highly durable. Gives a smooth, hard, light-colored, paintable surface.

EAGLE-PICHER STALASTIC
(Boiler Wall Coating)

Effectively seals against air infiltration through boiler settings—seals cracks and pores, effects substantial fuel savings. Great adhesive strength, retains its elasticity. For temperatures up to 400°F.

An Eagle-Picher Industrial Insulation distributor or representative can help you reduce operating expenses because he has available a wide line of insulation products—for high and low temperatures—scientifically designed for maximum thermal efficiency, and practical application. Why not let him give you more information about some of the products listed here?

These Eagle-Picher products can save you money . . . power . . . time

Insulating Felts • Superlemp Blocks • Blankets
Loose Wool • Pipe Covering • Stalastic • Insulsaal • Insulstic
Sweetchek • Finishing Cements • Insulating Cements
Fireproofing Cement • Diatomaceous Earth Blocks

THE EAGLE-PICHER COMPANY

General Offices: Cincinnati (1), Ohio

Insulation products of efficient mineral wool—for a full range of high and low temperatures. Technical data on request.

EAGLE EP PICHER

Since 1843

Get maximum fuel savings and exact temperature control with these versatile, efficient insulations

For a completely effective, low-cost insulation combination, you can't beat the teamwork of Eagle-Picher Supertemp Blocks, Diatomaceous Earth Blocks #85 (for temperatures to 1300°F.) and DE Blocks #95 (for temperatures to 2000°F.), Eagle-Picher Super "66" Insulating Cement, and Eagle-Picher Insulseal. They work effectively to give your equipment the highest possible thermal efficiency . . . cut operating costs by saving maximum amount of fuel . . . and help to provide perfect, precise control over temperatures.

EAGLE-PICHER SUPER "66" INSULATING CEMENT

Super "66" is all-purpose, rust-inhibitive, extremely adhesive insulating cement. "Springy ball" pellets don't collapse after application . . . give great coverage, retain their thermal efficiency. 100 lbs. covers 65 sq. ft.— 1 inch thick! Easily applied with trowel, over flat and irregular surfaces. Efficient for temperatures up to 1800° F. Reclaimable when used on equipment whose temperatures go up to 1200° F.

EAGLE-PICHER SUPERTEMP BLOCKS

Eagle-Picher Supertemp Blocks are lightweight (approximately 16 lbs. per cu. ft.). Can be cut easily with knife or saw to fit off-shaped areas . . . they fit snugly over minor irregularities. They're strong and have high refractory value. Withstand temperatures up to 1700° F. Conductivity at 512° F. approximately 0.43 . . . all standard sizes, from 3" x 18" to 12" x 36" . . . in thicknesses from 1" to 4".

EAGLE-PICHER INSULSEAL

A tough, weatherproof, protective coating for insulation. For temperatures up to 450° F. Applied as a plastic, its smooth troweling qualities assure uniform coverage, proper thickness. It protects insulation from air infiltration, fumes, rain, snow, vibration, punctures, and withstands severe service, indoors or out. Dries to a smooth, rich black, has a neat appearance on hot or cold surfaces . . . may be washed or painted.

THE EAGLE-PICHER COMPANY General Offices: Cincinnati (1), Ohio

Insulation products of efficient mineral wool—for a full range of high and low temperatures. Technical data on request.

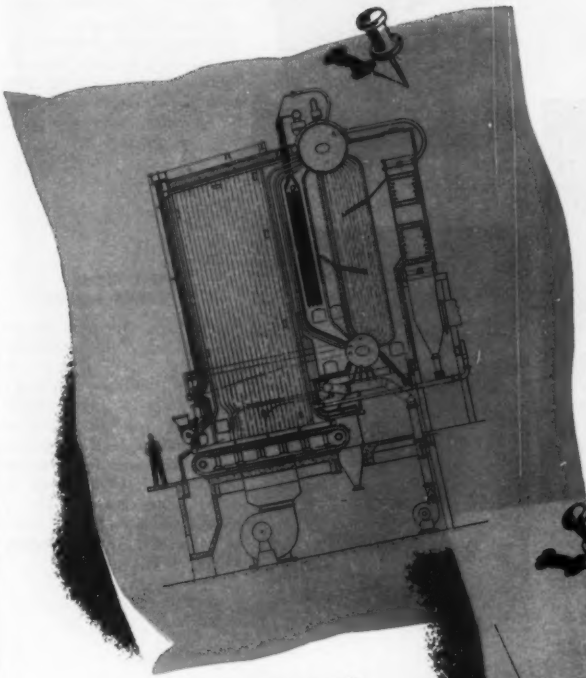
EAGLE EP PICHER *Since 1843*

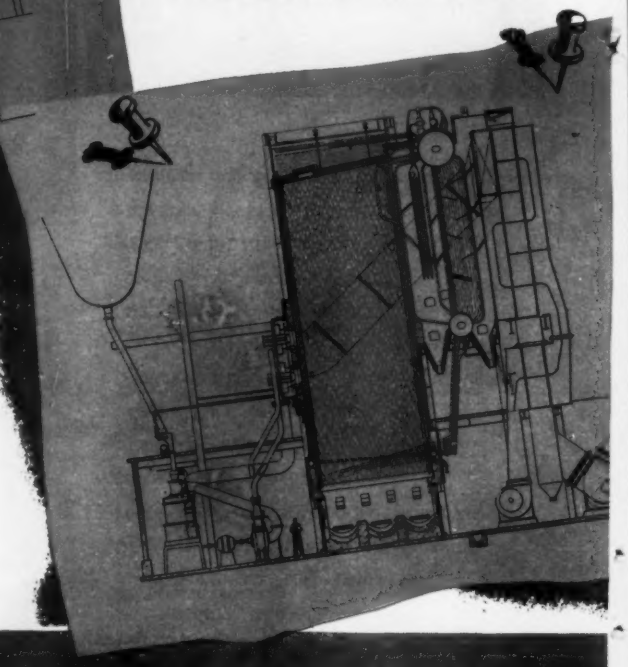
They keep coming

Companies that have bought **VU Boilers** *continue to buy them.* In fact, a substantial proportion of all VU Units, in service and on order, have been purchased by organizations whose selection reflects their own first-hand experience. *For example —*

A STEEL COMPANY now has a total of eleven VU Boilers in four different plants. Starting with three units in 1936, it has reordered three times... most recently in the fall of last year with an order for three more units.

A TEXTILE MANUFACTURER ordered two VU Units in 1936. Another unit was installed in 1940 and a third in 1944. Still another





VU-50 Unit fired with C-E Spreader Stoker (continuous discharge type). The capacity of unit shown is 80,000 lb steam per hr; operating pressure 425 psi steam temperature 650 F.

VU-50 Unit fired with pulverized coal. The capacity of unit shown is 200,000 lb of steam per hr; operating pressure 560 psi; steam temperature 760 F (VU units are in service for capacities up to 350,000 lb of steam per hr).

COMBUSTION ENGINEERING

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

back for more!

textile company installed one unit in 1945, a second in 1949 and has just ordered another.

A REFINING COMPANY ordered one VU Unit in 1937, another in 1940 and another in 1949 for one of its plants; also two in 1942 and one in 1947 for another plant.

A SEWAGE TREATMENT PLANT in one of America's large cities is another consistent buyer of VU Boilers. Its initial order in 1936 was for two units. Since then it has reordered three times, and now has a total of seven VU Boilers in service.

• • •

The story is the same wherever you go — in all sections of the country American industry is ordering and *reordering* VU Units. Why? Because the VU's advanced design, sound construction and consistent reliability have become a service-proved answer to lower steam costs. Once you have a VU Unit in service you soon *know* why so many large steam users *keep coming back for more.* B-481

VU-10 Unit fired with Type E Stoker. VU-10 Boilers range in capacity from 10,000 to 60,000 lb steam per hr. They may be fired by spreader, underfeed or traveling grate stokers, or by oil or gas.

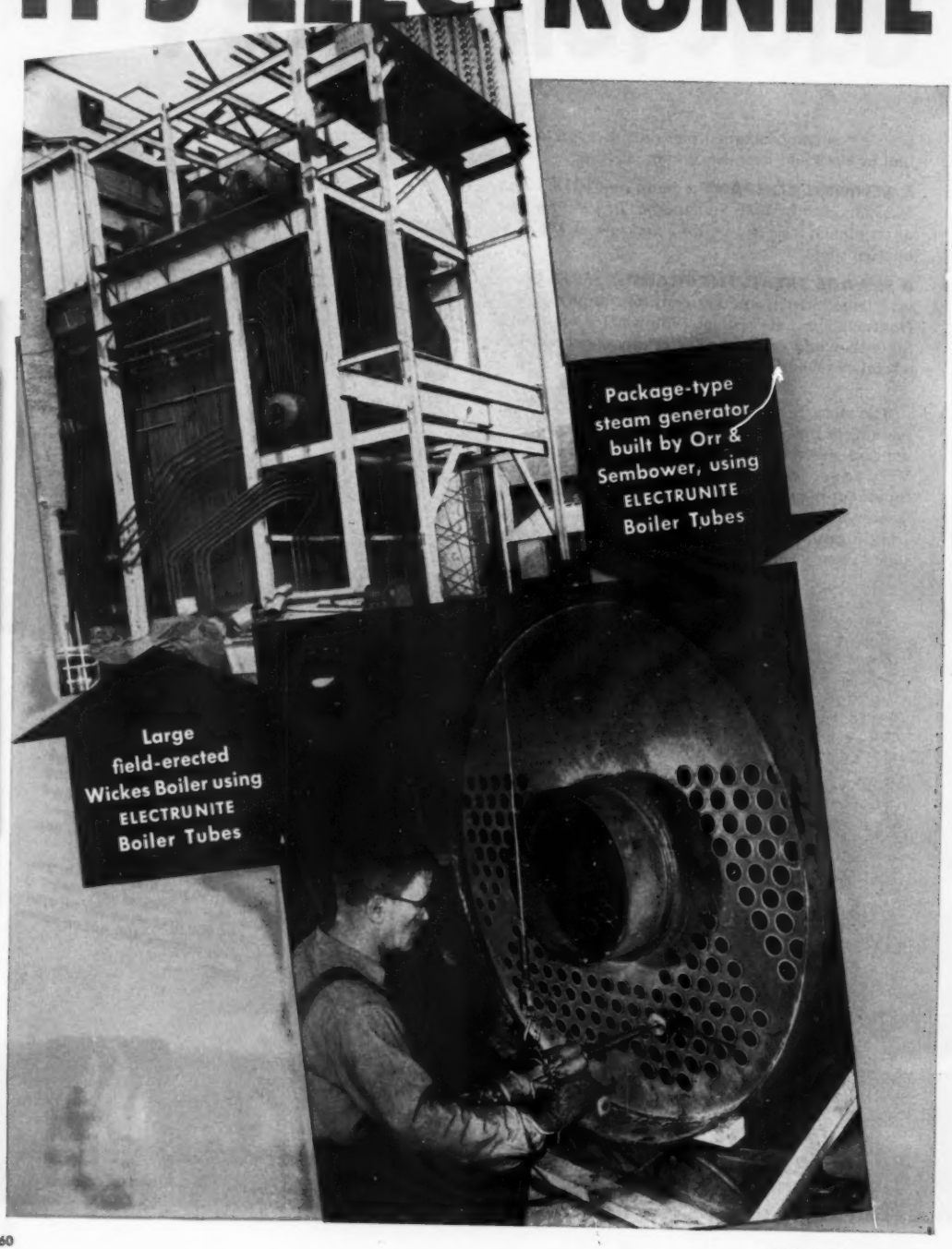
VU-50 Unit fired with oil or gas. The capacity of unit shown is 175,000 lb of steam per hr; operating pressure 400 psi; no superheat.

— SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E

IT'S ELECTRUNITE


Package-type steam generator built by Orr & Sembower, using ELECTRUNITE Boiler Tubes
Large field-erected Wickes Boiler using ELECTRUNITE Boiler Tubes

BOILER TUBES...

for

FIELD-ERECTED GIANTS....

or

FACTORY-ASSEMBLED PACKAGES!

● Specify ELECTRUNITE Tubes for your new boilers . . . retube your present units with ELECTRUNITE Tubes . . . a wide range of sizes and wall thicknesses enables ELECTRUNITE Tubes to meet practically all boiler size and pressure requirements.

Give your boilers these proved advantages of ELECTRUNITE Tubes . . .

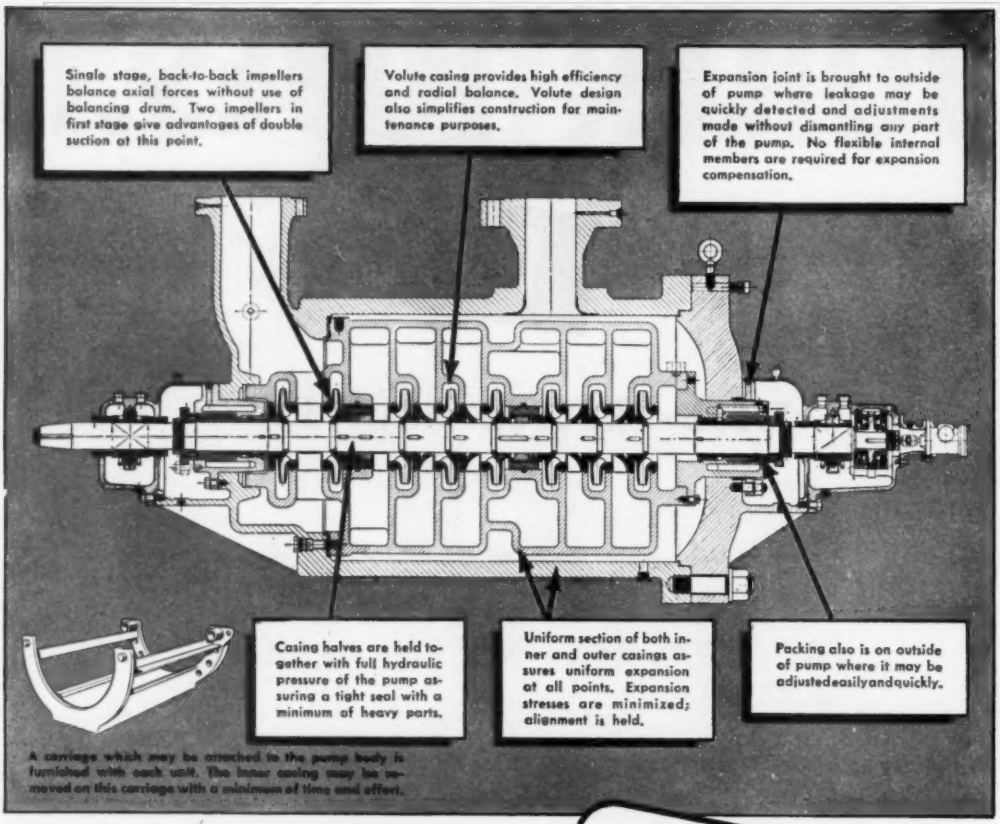
Proper ductility to provide tight, predictable roll-in. ELECTRUNITE Tubes are uniform in grain structure, ductility and wall thickness . . . free from slivers, hard spots, and scabs that cause costly delays in rolling-in.

The ELECTRUNITE Process of making tubes permits two-side inspection of the flat-rolled steel before forming and electric-resistance-welding into a uniform, homogeneous tube. Thorough inspection and testing after manufacture make sure you'll get maximum dependability and long life from ELECTRUNITE Tubes.

Write today for Bulletin BT-12 describing ELECTRUNITE Pressure Tubing and listing sizes, gages, and analyses.

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Dept.: Chrysler Building, New York 17, N.Y.

Republic
REPUBLIC STEEL
ELECTRUNITE
BOILER, CONDENSER AND HEAT EXCHANGER TUBES


Single stage, back-to-back impellers balance axial forces without use of balancing drum. Two impellers in first stage give advantages of double suction at this point.
Volute casing provides high efficiency and radial balance. Volute design also simplifies construction for maintenance purposes.
Expansion joint is brought to outside of pump where leakage may be quickly detected and adjustments made without dismantling any part of the pump. No flexible internal members are required for expansion compensation.
Casing halves are held together with full hydraulic pressure of the pump assuring a tight seal with a minimum of heavy parts.
Uniform section of both inner and outer casings assures uniform expansion at all points. Expansion stresses are minimized; alignment is held.
Packing also is on outside of pump where it may be adjusted easily and quickly.
A carriage which may be attached to the pump body is furnished with each unit. The inner casing may be removed on this carriage with a minimum of time and effort.

Cost Cutting Features

ALLIS-CHALMERS

NEW BOILER FEED PUMP

HERE IS A PUMP designed to meet the needs of the newer high pressure boiler plants. Efficiency is high, maintenance is low and every design feature has a long record of successful application to boiler feed service.

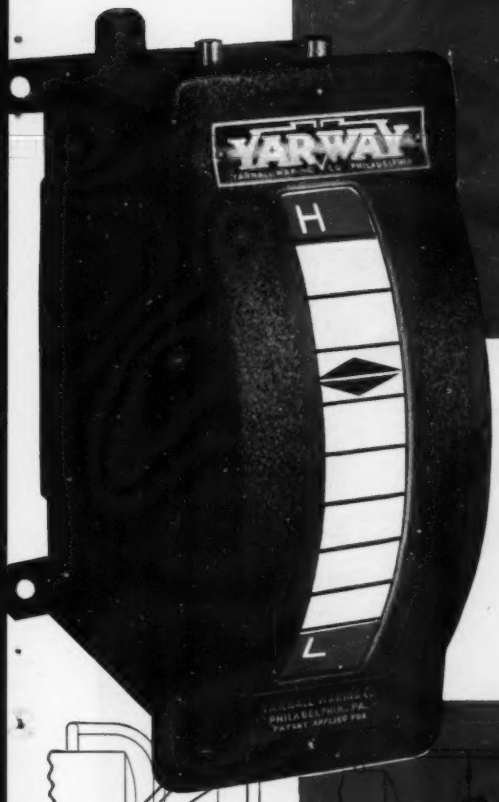
Sizes range from 1200 to 2500 psig and from 300 to 2000 gpm. Allis-Chalmers can supply the complete boiler feed pump installation including pump, motor and control, of coordinated design and manufacture.

Get the details on this new boiler feed pump from your Allis-Chalmers Sales Office or write Allis-Chalmers, Milwaukee 1, Wisconsin

A-3250

A-C ALLIS-CHALMERS

ALLIS-CHALMERS



YARWAY REMOTE LIQUID LEVEL INDICATOR

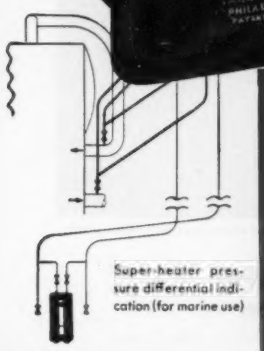
How many applications fit your plant needs?

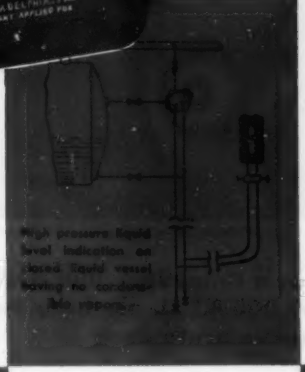
Versatility is just one feature of the Yarway Remote Liquid Level Indicator . . . leading to a variety of installation possibilities in any plant.

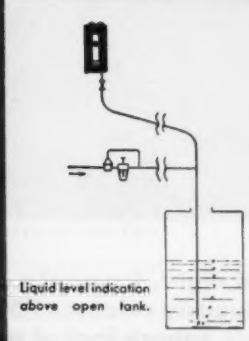
Wherever it's used, instant accurate level indication is always assured because the Yarway Indicator is operated by the liquid itself — by the pressure differential between constant head and the varying head. Magnetic transmission. No stuffing boxes.

Write for Bulletin WG-1833, or Bulletin WG-1830 on the *Recording* Indicator for the same applications.

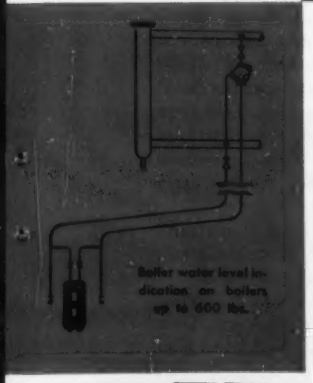
YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Penna.
BRANCH OFFICE IN ALL PRINCIPAL CITIES

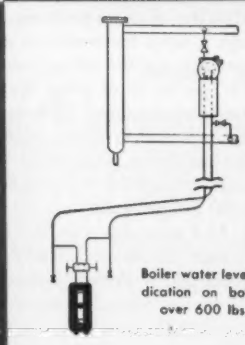

Super-heater pressure differential indication (for marine use)

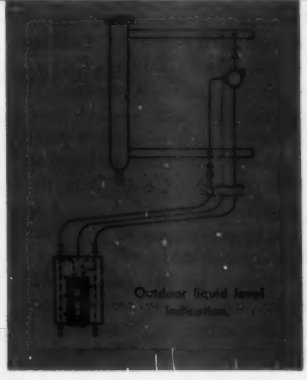

High pressure liquid level indication on closed liquid vessel having no condensate leg requirements

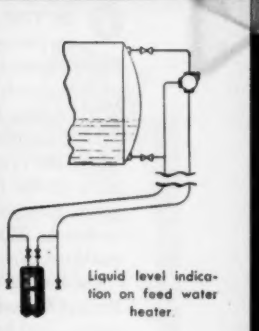

Liquid level indication above open tank.

Liquid level indicators on elevated tanks


Boiler water level indication on boilers up to 600 lbs.

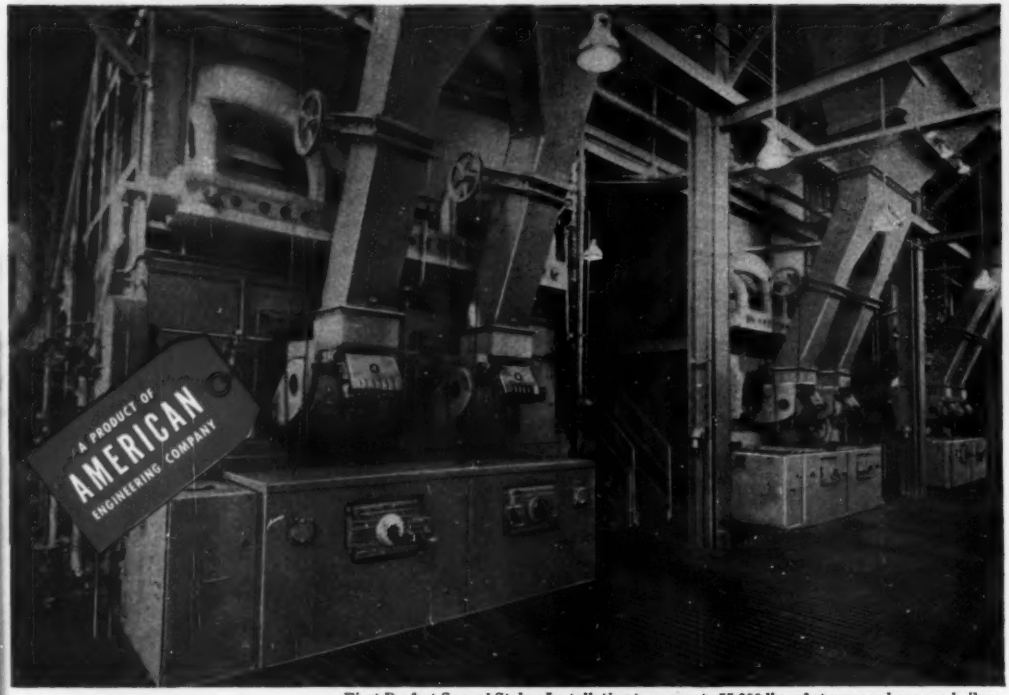

Boiler water level indication on boilers over 600 lbs.


Outdoor liquid level indication.


Liquid level indication on feed water heater.

YARWAY REMOTE LIQUID LEVEL INDICATOR

1... 2... and now a 3rd order for



First Perfect Spread Stoker Installation to generate 55,000 lbs. of steam per hour per boiler.

Day and night, for weeks at a time, Spreader Stoker continuously releases 700,000 B.T.U. per hour per square foot of active grate area

1 IN THE FALL of 1949 a very well known corporation installed three AE Perfect Spread Stokers to generate 55,000 lbs. of steam per hour each in one of its midwest plants.

2 Months later the Company needed more steam from larger boilers in another plant where the existing stokers had been designed to burn 12,300 B.T.U. per pound coal. Over the years, however, the available coal dropped to as low as 9500 B.T.U. per pound so the plant could not carry the required load.

On the basis of proved performance, an AE Perfect Spread Stoker was installed as a replacement... and here's the record:

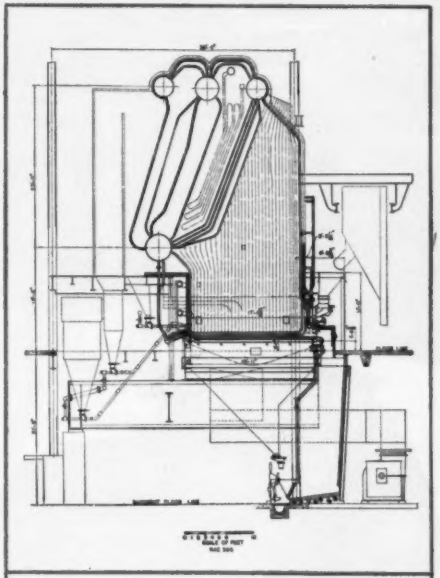
The Perfect Spread has averaged better than 180,000 lbs. of steam per hour—24 hours a day—7 days a week for weeks on end. Efficiency is about 84% and the release rate exceeds 700,000 B.T.U. per sq. ft. of active grate area per hour! In terms of sustained results per sq. ft. of grate surface this is probably the highest duty spreader stoker installation in the world. With an increased manufacturing load they now find they can carry 200,000 lbs. per hour.

3 And now, again on the basis of performance, the same company has ordered two more duplicate Perfect Spread Stokers.*

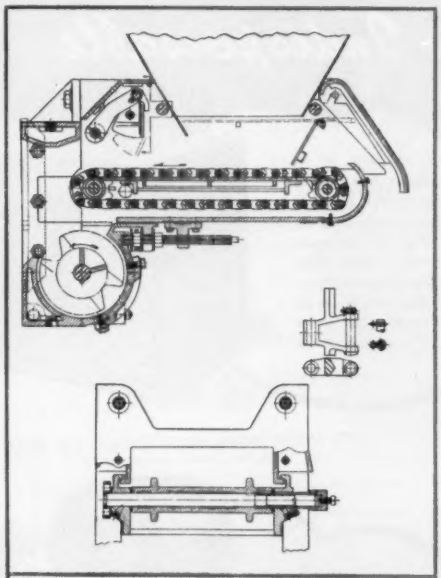
AE Perfect Spread Stokers burn high and low ash coals with practically equal efficiency. They assure positive, continuous coal feed and unbe-

*AS THIS MESSAGE WAS GOING TO PRESS, THE ABOVE COMPANY PLACED A FOURTH ORDER FOR A PERFECT SPREAD STOKER.

PERFECT SPREAD STOKERS



Second larger installation of Perfect Spread Stoker actually giving 200,000 lbs. of steam per hour from a single boiler.



NON-CLOGGING CONVEYOR FEEDER: Coal enters feeder from hopper, and is conveyed positively, continuously and uniformly forward. Coal is not fed in slugs.

lieveably even distribution. *They never clog on wet coal.*

Perfect Spread Stokers have a capacity range from 8,000 to 500,000 lbs. of steam per hour... coal feeders are adjustable from 50 lbs. to 7500 lbs. of coal per hour. Mail coupon today for a copy of the Perfect Spread Stoker booklet and for a reprint of a new report on large spreader stokers. Also, if you are now considering a boiler in capacities from 300,000 to 500,000 lbs. of steam per hour, let's arrange to get together and discuss cross-firing.

WON'T CLOG ON WET COAL

AMERICAN ENGINEERING
COMPANY
PHILADELPHIA 25, PENNA.

AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers.

American Engineering Company
2400 Aramingo Avenue
Philadelphia 25, Penna.

Gentlemen: Kindly send me free copy of Perfect Spread Stoker booklet and new stoker report ☐. I should like to discuss cross-firing ☐.

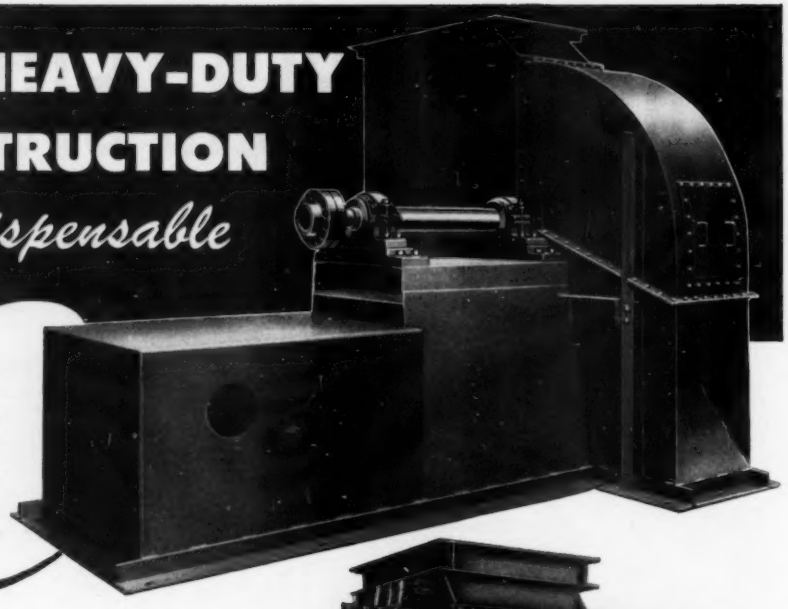
Name_____ Title_____

Company_____

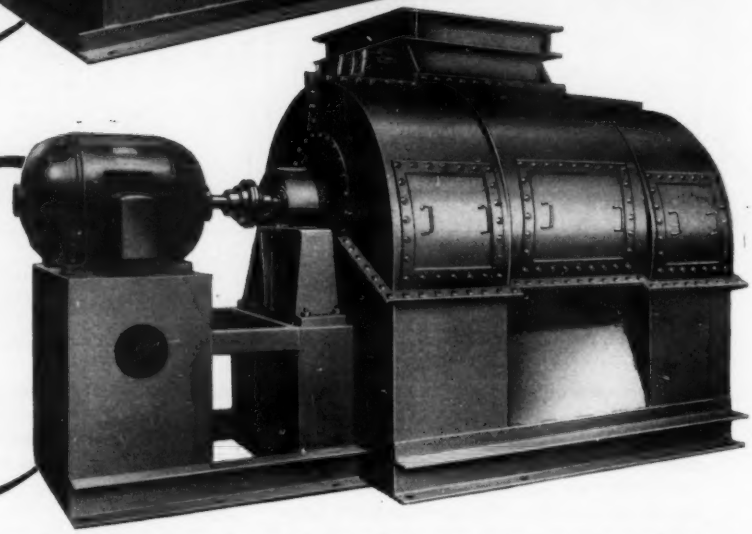
Address_____

City_____ Zone____ State____

Now HEAVY-DUTY CONSTRUCTION *is Indispensable*



HEAVY-DUTY single width fan for handling large volumes of air at high pressures—either supply or exhaust applications. Speeds suitable for motor or turbine drive.



HEAVY-DUTY double width fan for handling large volumes of air at medium high temperatures. Fan cooled bearings (Clarage development) insures satisfactory operation despite heat.

YOU CAN'T TOLERATE PROCESS AIR FAILURES IN DEFENSE PRODUCTION

Durability plus! . . . fan equipment to master the toughest assignments . . . fans to meet any size, any type of air handling need! **Clarage HEAVY-DUTY equipment** is built above and beyond the demands of average service. It is the make of equipment so many engineers in industry prefer for their **most important fan jobs.** We welcome your inquiry for any desired data.

CLARAGE

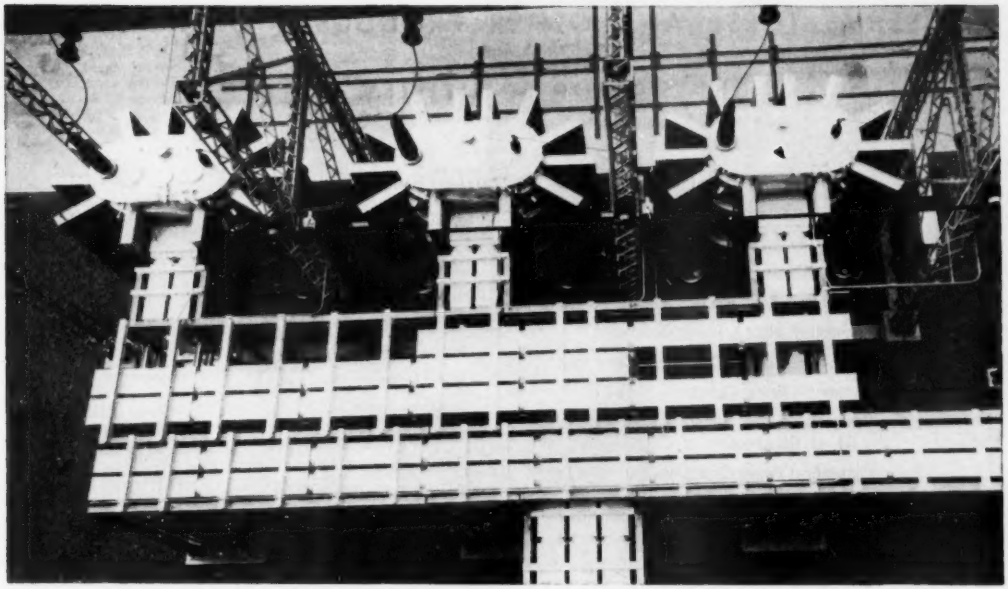
—HEADQUARTERS for Air Handling and Conditioning Equipment

CLARAGE FAN COMPANY

KALAMAZOO, MICHIGAN

APPLICATION ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

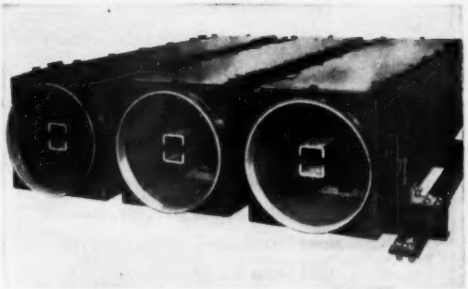
Vital Station Interconnections Get Maximum Protection



isolated-phase bus

With G-E isolated-phase bus runs for vital interconnections between generators, transformers and main switchgear, you know that every precaution is taken to insure freedom from faults of every type. Dust-tight, weather-tight aluminum construction seals out many possible causes of flashover. Advanced G-E design reduces the number of creepage surfaces without sacrifice of mechanical strength. Supplied in either individual-phase sections or as a complete three-phase package, G-E isolated-phase buses simplify installation problems and cut costs.

Your G-E sales representative has complete information. Ask him for a copy of GEA-5460, a 28-page publication that will aid you in planning your buses, or write to General Electric Company, Schenectady 5, N. Y.



Typical three-phase section of G-E isolated-phase bus. Bus is copper, channel-type to provide maximum strength. Silver contact surfaces assure full flow of current and eliminate oxidation troubles. Insulators conform to NEMA standards, are normally carried in stock in power stations. Gasketed, aluminum cover has two sets of hinges to permit opening from either side. Lugs release covers without removal of any bolts. End bells are welded to housing. Adjacent ring flanges are tightly joined by split aluminum bands whose mating edges are also gasketed.

855-26

GENERAL ELECTRIC

IT HAS BEEN AMERICAN BLOWER'S PRIVILEGE TO SERVE THESE AND OTHER PRODUCERS OF POWER IN THE PUBLIC UTILITY FIELD

Buffalo Niagara Electric Corporation
Central Arizona Power & Light Company
Central Illinois Electric & Gas Company
Central Illinois Light Company
Columbus & Southern Ohio Electric Company
Connecticut Light & Power Company
Consolidated Edison Company of New York
Consumers Power Company
Consolidated Gas, Electric Light & Power Co. of Baltimore
Connecticut Power Company
Dairyland Power Co-operative
Dallas Power & Light Company
Detroit Edison Company, The
Duke Power Company
Eastern Shores Public Service Company
Fitchburg Gas & Electric Light Company
Florida Power Corporation
Florida Power & Light Company
Gulf Power Company
Hartford Electric Light Company
Indianapolis Power & Light Company
Iowa Public Service Company
Iowa-Illinois Gas & Electric Company
Iowa Power & Light Company
Iowa Electric Light & Power Company
Kansas City Power & Light Company
Kansas Power & Light Company, The
Kansas Gas & Electric Company
Long Island Lighting Company
Los Angeles, California, City of
Louisiana Power & Light Company
Madison Gas & Electric Company
Mississippi Power Company
Missouri Power & Light Company
Nebraska Power Company
North Carolina Power Company
Northern Indiana Public Service Corporation
Ohio Edison Company
Oklahoma Gas & Electric Company
Omaha Public Power District
Otter Tail Power Company
Pacific Gas & Electric Company
Pennsylvania Power Company
Philadelphia Electric Company
Potomac Electric Power Company
Public Service Company of Oklahoma
Public Service Electric & Gas Company
Public Service Company of Colorado
Southwestern Public Service Company
Southern Indiana Gas & Electric Company
South Carolina Power Company
Springfield, Illinois, City of
Tampa Electric Company
Texas Electric Service Company
Texas Power & Light Company
Tennessee Valley Authority
Virginia Electric & Power Company
Worcester County Electric Company of Massachusetts

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN

Serving home and industry

AMERICAN-STANDARD · AMERICAN BLOWER · CHURCH SEATS · DETROIT LUBRICATOR · KEWANEE BOILERS · ROSS HEATER · TONAWANDA IRON

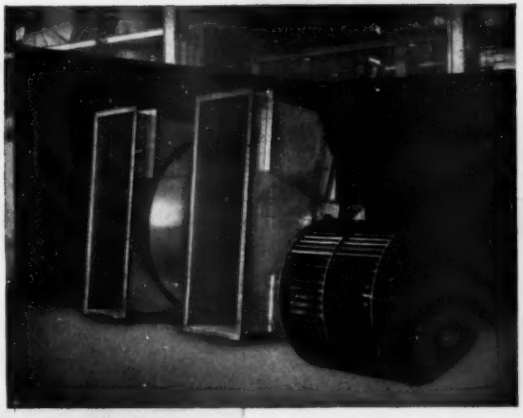
Mechanical Draft Fans

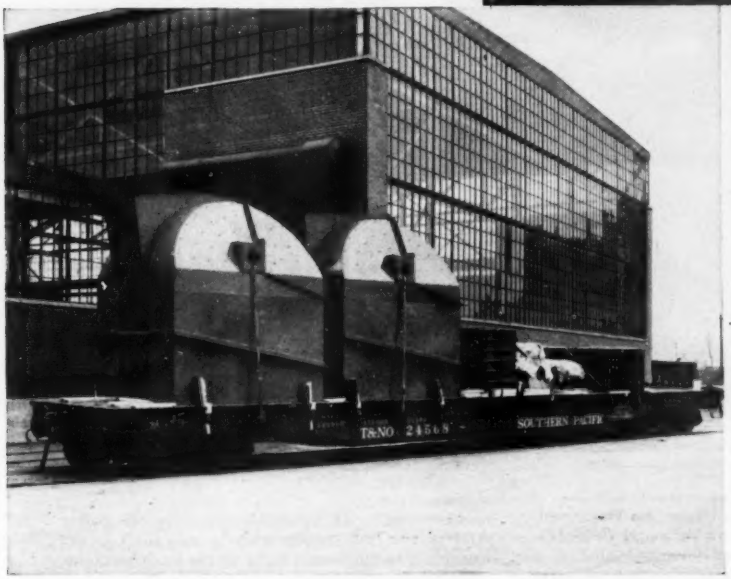
for

Potomac Electric Power Co.

Benning Station, Washington, D.C.

To supply the ever-increasing demand for electric power in the Washington, D.C. area, still another of America's great public utilities, Potomac Electric Power Co., is expanding and enlarging its facilities and services.





Above is shown one of 2 American Blower Forced Draft Fans ready to be loaded on a freight car for shipment to the Potomac Electric Power Co., Benning Station. Each fan will be equipped with louvre controls and outlet dampers. The capacity of each fan is 135,000 CFM at 100° F. at 15.8" SP.

The photograph at the left shows 2 American Blower Induced Draft Fans loaded on a freight car and ready for shipment.

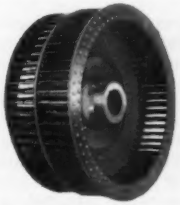
These fans will be equipped with inlet and outlet dampers and each has a capacity of 171,000 CFM at 330° F. at 22.0" SP.

You'll find dependable American Blower Mechanical Draft Fans measure up to the most exacting power plant requirements. High static efficiency, low R.P.M., low tip speed and low inlet velocity are but a few of the many reasons these fans have found such wide acceptance with public utilities.

For complete information, contact your nearest American Blower Branch Office.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICH.
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation



The Sirocco Wheel

The unique and scientific design of the Sirocco wheel provides a structure of unusual strength, unobstructed for smooth air flow. The blades are die formed, assuring exact duplicates, and are machine riveted to the backplate and rim, so that each blade is set in the wheel at exactly the correct angle.

YOUR BEST BUY AMERICAN BLOWER POWER PLANT EQUIPMENT

Serving home and industry

AMERICAN-STANDARD · AMERICAN BLOWER · CHURCH SEATS · DETROIT LUBRICATOR · KEWANEE BOILERS · ROSS HEATER · TONAWANDA IRON

MINNEAPOLIS Honeywell BROWN INSTRUMENTS

. . . symbol of simplified operation and maintenance

It will pay you to take a good look

. . . at the PYR-O-VANE and PROTECT-O-VANE controllers

Panelboard showing Pyr-O-Vane and Protect-O-Vane Controllers for travelling oven at International Resistance Co.

LIKE all other products that bear the Honeywell nameplate, the Brown *Pyr-O-Vane* and *Protect-O-Vane* Electonic Controllers have established a reputation for sound design, trouble-free performance, and flexibility of application . . . all of practical importance to superintendents, engineers and instrument men.

Both instruments reflect years of experience in pyrometer construction. Galvanometer unit in each, incorporates a new high resistance circuit that provides an accuracy to ± 1% of total span. The electronic vane-type control unit provides a continuous *knife-edge* control, with snap action at the control point. Fluctuating line-voltages and changes in ambient temperatures and humidity have little or no effect on accuracy. Sensitivity of control is easily adjusted to meet individual control requirements or abnormal vibration conditions.

The *Pyr-O-Vane* is ideal for practically all temperature control applications. It is available with on-off, two or three position control.

The *Protect-O-Vane* is especially designed to protect electric and fuel-fired furnaces from excess temperatures. It automatically cuts off power and/or the fuel supply when a safe limit is exceeded. Flashing neon light warns of excess temperature . . . audible alarm may be sounded, if desired. Manual reset button will not re-start furnace until the temperature drops to a safe point.

Check These PERFORMANCE *Features:*

- √ *Snap-action control relay is highly responsive to changes in thermocouple emf.*
- √ *Separately enclosed high-resistance galvanometer is exceptionally stable and has high sensitivity.*
- √ *Vane-type electronic control provides continuous non-cyclic action.*
- √ *Control sensitivity easily adjusted to meet individual control requirements or abnormal vibration changes.*
- √ *"Fail-safe" design and thermocouple burn-out feature protects work load. Neon light warns of component failure.*
- √ *Plug-in design reduces maintenance, simplifies servicing.*
- √ *Universal case . . . for flush or surface mounting.*
- √ *Easily installed, low in cost.*

Ruggedly constructed, simply designed units permit easy removal when servicing or replacement is required. Plug-in feature of galvanometer and control units eliminates damage to measuring and control elements . . . provides greater efficiency in making range changes or adjusting control to fit particular requirements.

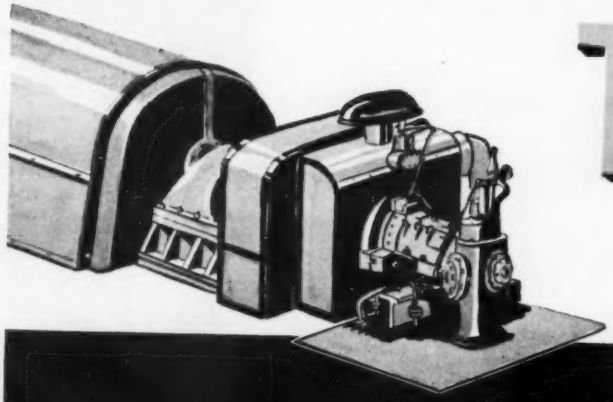
Typifying the many advantages afforded by the *Pyr-O-Vane* and *Protect-O-Vane* electronic controllers, is the *plug-in* feature of their measuring and control units. Unit construction provides a definite *plus* factor in easy removal for servicing, or range change which may be made by simply plugging-in another galvanometer. All control units for any given voltage and frequency are identical and can be used for any scale range.

The two compartments of the case are provided with separate covers, completely protecting galvanometer and control unit from dust and moisture. The upper compartment houses the high resistance galvanometer while the lower contains the vane-type electronic control unit.

Take a *good look* at these unusual features . . . call in your local Honeywell engineer for a discussion of their utilization in your plant. Specification sheets Nos. 112 and 113 sent on request.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4490 Wayne Ave., Philadelphia 44, Pennsylvania. Offices in more than 80 principal cities of the United States, Canada and throughout the world.

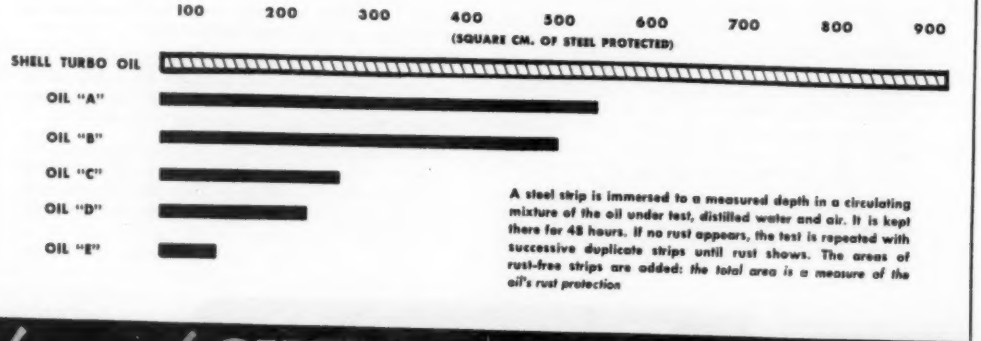
MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS



Today's

Improved SHELL TURBO OIL

"LOOK AT THESE RUST-PROTECTION FIGURES"



A steel strip is immersed to a measured depth in a circulating mixture of the oil under test, distilled water and air. It is kept there for 48 hours. If no rust appears, the test is repeated with successive duplicate strips until rust shows. The areas of rust-free strips are added: *the total area is a measure of the oil's rust protection*

Improved SHELL TURBO OIL for

Surest Safeguard

for MAJOR TURBINE INVESTMENT

The one lubricant that provides this

outstanding 5-way protection

Because of the tremendous responsibility entrusted to operators of large steam turbines, and because of the heavy investment each unit represents, Shell Oil Company has been concentrating on a lubricant research project of primary importance to utility and industrial executives.

The product now offered, Improved SHELL TURBO OIL, exceeds *every* accepted specification for premium turbine lubricants. It offers these five outstanding improvements:

1. **Highest known rust protection**—An entirely new combination of rust inhibiting additives effectively retards the formation of rust—an action which with proper maintenance will continue for the life of the turbine. Rusting problems are reduced to the very minimum in any turbine protected by Improved Shell Turbo Oils.

2. **Outstanding Oxidation Stability**—Improved Shell Turbo Oil contains the same time-proved anti-oxidant which has compiled such an extraordinary record of oxidation stability in the original Shell Turbo Oil. Service records for turbine units of all sizes . . . many operating for 10 to 13 years . . . show complete stability with respect to oxidation and sludge formation. In each of these units the oil gives every indication of matching the operating life of the turbine itself.

3. **Anti-foaming**—With the effective anti-foam agent now in Shell Turbo Oil, air entrainment can be tolerated for considerable periods, thus avoiding unscheduled shutdown.

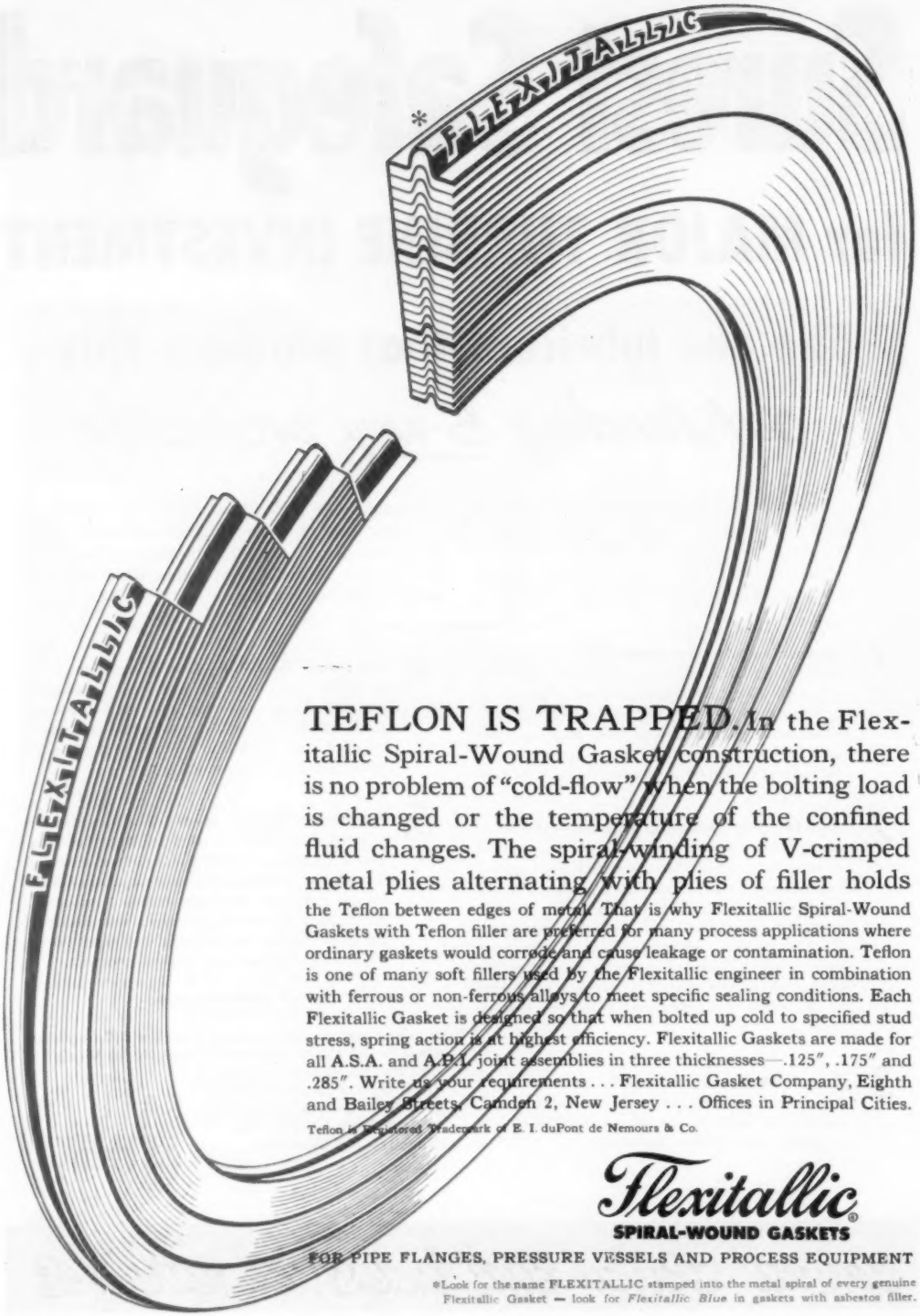
4. **Excellent Emulsion Characteristics** — Improved Shell Turbo Oil provides the greatest protection against rust and oxidation yet achieved. Moreover, this protection is attained without any tendency to form objectionable water emulsions in service.

5. **Protection against wear**—The specially developed rust inhibitor used in Improved Shell Turbo Oil has the added faculty of reducing surface wear . . . adding to the protection afforded by the Oil itself. Because of this "anti-wear" effect, Shell Turbo Oil provides a welcome margin of safety for the bearings and gears during the critical starting and stopping periods.

Samples and complete information on the Improved Shell Turbo Oil will be sent promptly on receipt of your letterhead request. Address: Shell Oil Company, 50 West 50th Street, New York 20, N.Y. or 100 Bush Street, San Francisco 6, California.

SHELL

central station and industrial turbines



TEFLON IS TRAPPED. In the Flexitallic Spiral-Wound Gasket construction, there is no problem of "cold-flow" when the bolting load is changed or the temperature of the confined fluid changes. The spiral-winding of V-crimped metal plies alternating with plies of filler holds

the Teflon between edges of metal. That is why Flexitallic Spiral-Wound Gaskets with Teflon filler are preferred for many process applications where ordinary gaskets would corrode and cause leakage or contamination. Teflon is one of many soft fillers used by the Flexitallic engineer in combination with ferrous or non-ferrous alloys to meet specific sealing conditions. Each Flexitallic Gasket is designed so that when bolted up cold to specified stud stress, spring action is at highest efficiency. Flexitallic Gaskets are made for all A.S.A. and A.P.I. joint assemblies in three thicknesses—.125″, .175″ and .285″. Write us your requirements . . . Flexitallic Gasket Company, Eighth and Bailey Streets, Camden 2, New Jersey . . . Offices in Principal Cities.

Teflon is a Registered Trademark of E. I. duPont de Nemours & Co.

Flexitallic®
SPIRAL-WOUND GASKETS
FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Look for the name FLEXITALLIC stamped into the metal spiral of every genuine Flexitallic Gasket — look for *Flexitallic Blue* in gaskets with asbestos filler.

PHILIP SWAIN, EDITOR • MAY 1951 • ESTABLISHED 1882

Power
COMBINED WITH OPERATING ENGINEER

24 hours . . . 7 days . . . 52 weeks . . .

SHARP against a twilight sky, the power station of this issue's cover stands for all plants, big and little, in all corners of the country, where sunset marks a time of day, not the end of the day's work. It reminds us that the power job, now more important than ever, goes on 24 hours a day, 7 days a week, 52 weeks a year.

Like the blood in man's body, electric power must flow without interruption. And it must be made at the very instant of use, with no chance to stockpile.

No wonder "readiness to serve" comes first in the minds of those who manage our electric utilities. That's why they habitually look ahead for years and have never been caught napping. That's why even the demands of World War II failed to catch America unprepared in power.

In the light of today's situation, we can still learn from the power history of that gigantic conflict. From the start it was clear that victory would demand the greatest productive drive the world had ever known. It was equally clear that production would be stifled if power ran short.

How much power was needed? The answer to this question was critically important. Too little would throttle production. Excessive plant building would hold up much-needed ships and weapons.

Starting from the same set of facts, two opposite conclusions were reached. On one hand, the Federal Power Commission preached a power "shortage," pushed for a vast long-term construction program based on their estimates of load growth.

On the other, spokesmen for the power industry insisted that moderate additions to existing capacity would take care of all essential demands.

On the basis of its own study, POWER, as early as January 1942, took a public stand with those who opposed any heavy power-expansion plans as a dangerous and needless misdirection of national effort.

Fortunately these realistic counsels prevailed, because actual load growth proved only half of that predicted by FPC. The War Production Board then took over the estimating of power needs and allocated just enough materials and shop facilities for a modest 25% increase in the national power plant.

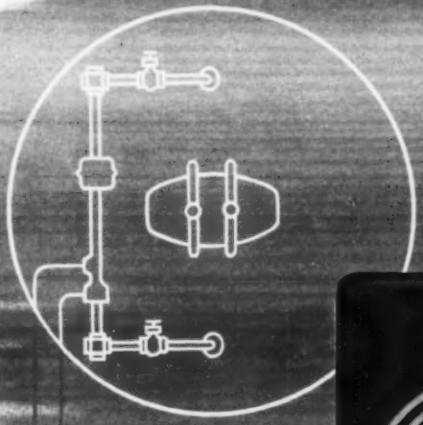
WPB's carefully calculated risk paid off and there was no power shortage. By reserving critical materials and shop space for ship's power plants and other war essentials this prudence in power expansion helped make victory early and sure.

Some will ask how a mere 25% addition to America's power capacity was able to support the vast war-production program. As power-wise men expected, much war production was merely a shift from civilian work. Night shifts and weekend work squeezed extra energy out of each kilowatt of capacity. Effective use of what we had helped, too. And we found we could operate with smaller reserves when the showdown came.

Today, as we head farther into another world emergency, this same flexibility of electric power is again assurance that we won't run short—particularly since building rate is greater than at the time of Pearl Harbor, and we have World War II experience to guide us.

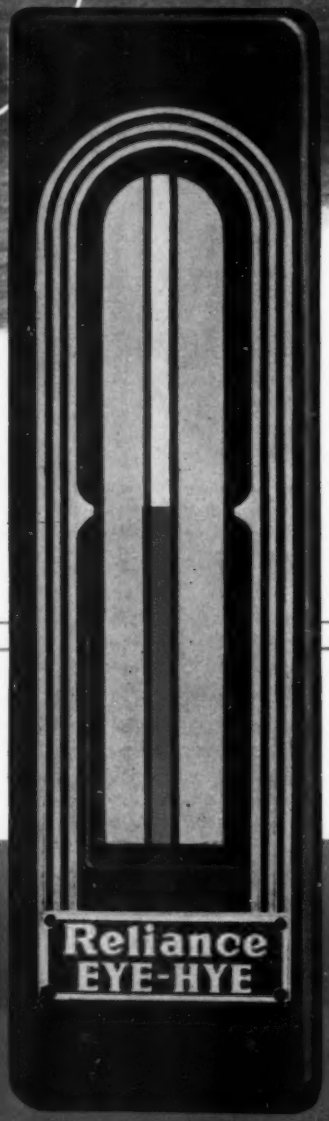
But never forget that this dependability of our power supply is more than mere statistics of capacity and load. Above all it is men—the men who design the equipment and the plants, the men who build them, and the men who operate and maintain them. Serving these men is POWER's job. And it's to keep pace with their ever-growing responsibilities that we work constantly to expand and improve POWER's editorial services.

EYE-HYE® helps



Reliance UNITEMP® — complete temperature equalizing unit—furnished with each EYE-HYE

Complete line of Water Columns, Water Gages and other trim for all working steam pressures



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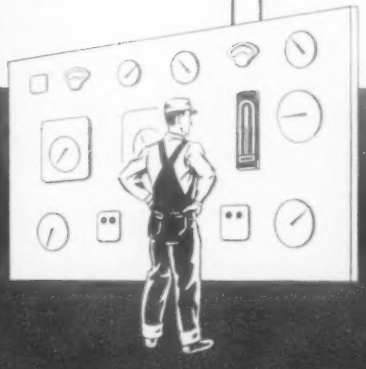

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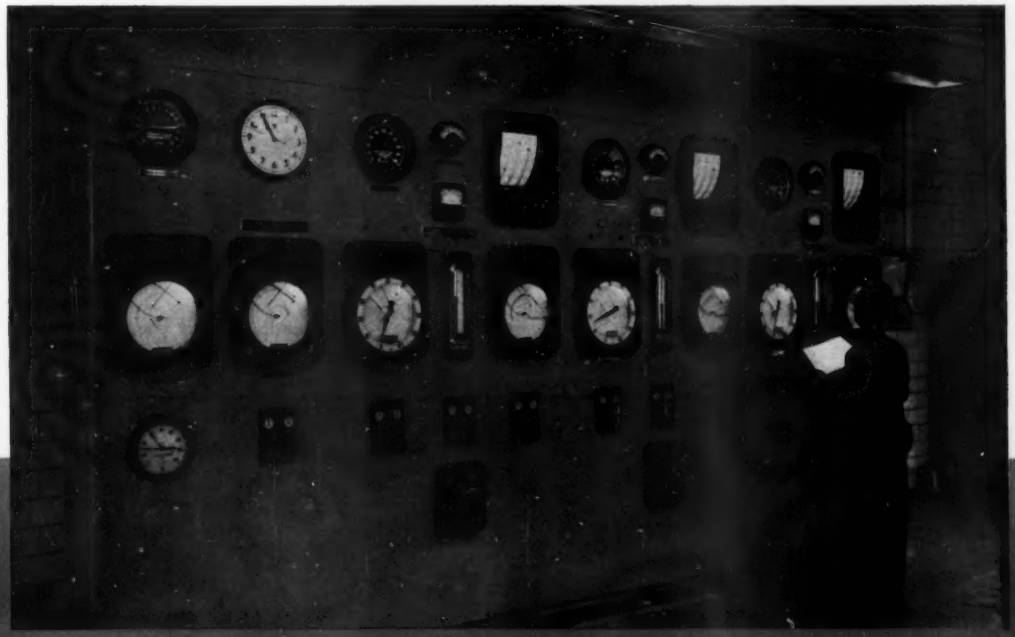

Three EYE-HYEs on panel board at The Jeffrey Mfg. Co., Columbus, Ohio

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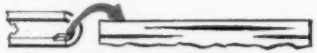
BOILER SAFETY DEVICES

OF THE LONGER LIFE OF BYERS WROUGHT IRON

Every engineer will recognize this picture as a notch-fracture test specimen . . . and will appreciate the unusual physical properties suggested by the break.

The hickory-like fracture results from the unique structure of wrought iron. Tiny threads of glass-like silicate slag, 200,000 to 250,000 per square inch of section, are distributed through a matrix of high-purity iron. This fibrous structure, which might be compared to that of a stranded wire cable, equips wrought iron to withstand sudden shock, and to resist fatigue induced by continuing vibration.

Of even more importance in the average application is the *corrosion resistance* of wrought iron . . . which also comes directly from the unique structure and composition of the material. If a small section of wrought iron were placed under a microscope, a few of the multitude of silicate slag fibers would show up as in this sketch.



If corrosion attacks this specimen, it would first cover the entire surface . . . then concentrate at one point, and work inward. Soon it would encounter one of the slag fibers . . . and since this fiber is unaffected by corrosion, the inward march would be halted. This action is shown by this sketch.

Corrosion is now "detoured." It works right and left, until it comes to the end of the fiber, when it may start to work inward again. The process is repeated when the second line of defense is encountered. Pitting, and rapid penetration of the metal, is discouraged. Useful life is determined by how long it takes for corrosion to reduce the entire body of metal to its safe limit of thickness, rather than by how long it takes corrosion to perforate the wall at a few vulnerable points. The fibers also anchor the initial protective scale, which shields the underlying metal.

Every cost sheet today confirms the fact that the most expensive material you can use is that which must be replaced too soon—and too often. The extra service of wrought iron is helping tens of thousands of users to cut maintenance costs. We will welcome an opportunity to review your piping problem with you—and to recommend the places where wrought iron—on the basis of its past performance—can be profitably used. Ask for our booklet, "THE A B C'S OF WROUGHT IRON."

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CORROSION COSTS YOU MORE THAN WROUGHT IRON

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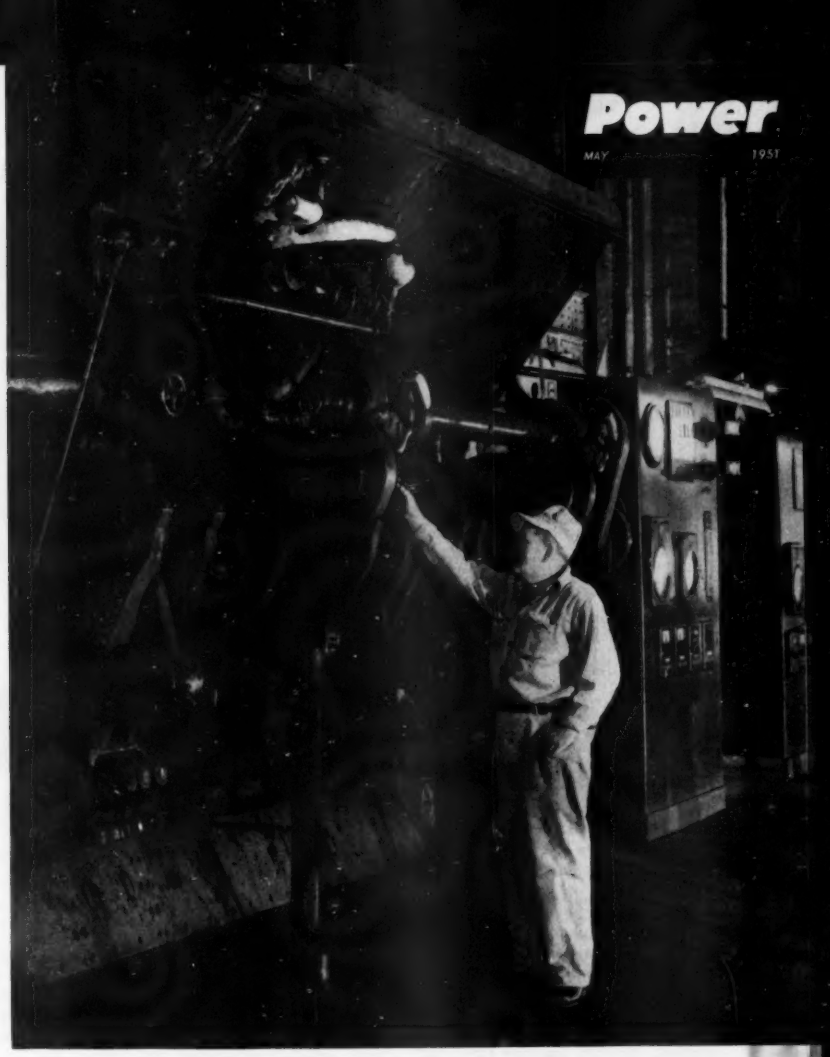
ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS



FIRESIDE DEPOSITS build up on the superheater, economizer and air-preheater surfaces so fast that they can force boiler shutdown. Here's a full-scale run on a stoker-fired boiler using a humidified combustion air that has extended boiler availability, reduced losses

Wet Combustion Air Reduces Slagging

► FIRESIDE DEPOSITS have long been a major boiler-room operating problem. Some definite progress has been made toward identifying their nature and causes. But no effective, long-time control over them has been developed to date. Some experiments[1], under way at the Delray Plant of the Detroit Edison Co, may point the way to this much needed control. They involve the use of a humidified air for combustion in 325,000-lb-per-hr, 865-psig, 910-F, underfeed, stoker-fired steam generator units.

The enthusiasm these experiments have touched off has been so widespread that POWER gives here a roundup report on (1) Delray experiments (2) later and similar experiences of another utility (3) reactions of the top experts, both here and abroad.

DELRAY EXPERIMENTS

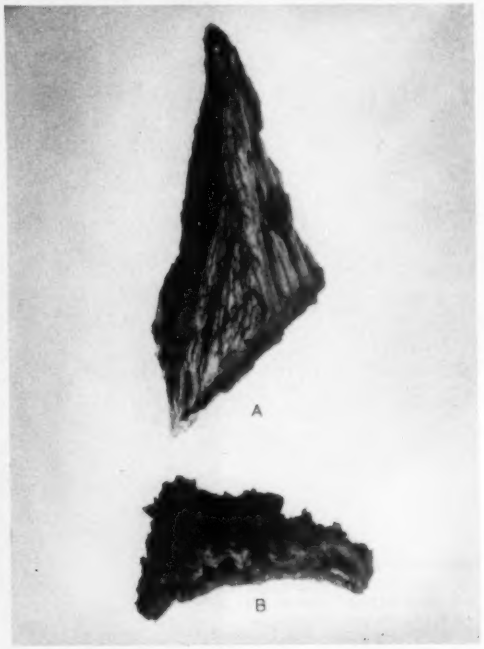
Behind the Detroit Edison Co experiments we find the rather common experience of initially clean fireside boiler surfaces fouled up within a few days of operation. Within about 50 days or so the deposit build-up got to the point where it forced a shutdown. Several contributory factors—interrupted coal feed, secondary combustion, superheater tube wastage—confused and aggravated the deposit problem. Once these confusing factors were brought under control Detroit Edison set in motion a 2-way project: (1) systematic study of published experiences with fireside deposits (2) investigation of a 1944 suggestion that humidification of combustion air might reduce them.

Causes. The fireside deposits at Delray were the alkali-matrix type most likely to form in stoker-fired plants, photos top of p. 72. This class of de-

[1] "Fireside Deposits in Steam Generators Minimized Through Humidification of Combustion Air," P J Murphy Jr, J D Piper, C R Schmansky, Detroit Edison Co. ASME Annual Meeting, Nov 26-Dec 1, 1950. Paper No. 50-A-86.

DEPOSIT BUILD-UP in the superheater with underfeed stoker firing normally increased draft loss 2⅜ in. in about 28 days

DEPOSIT COMPARISON: BEFORE, AFTER



SAMPLE A, ABOVE, is a typical 29-day superheater deposit with normal air. B is a 133-day deposit using a humidified air

posit forms because sodium, potassium, and, sometimes, lithium volatilize or are carried on flames from the fuel bed to the cooler boiler surfaces, particularly superheater tubes, where they condense. As they condense they react with sulfur trioxide at superheater temperatures to produce sticky, semi-fluid sulfates, bisulfates and pyrosulfates. There is some evidence that silicon, certain phosphorous, boron and vanadium compounds are also selectively volatilized from the fuel bed.

W F Harlow of England, p 74, believes the primary cause of all fireside deposits is the catalytic production of sulfur trioxide, SO_3.

Controls. Table on p 73 shows the four principal methods recommended to date for the control of fireside deposits. The first two were already in effect at Delray. That left only two: preventing SO_3 formation or minimizing the volatilization of the alkali salts of sodium and potassium. Because Harlow had already launched an extensive investigation of SO_3, Detroit Edison chose to study the possibilities of minimizing the volatilization of the alkali salts by control of the fuel-bed temperatures.

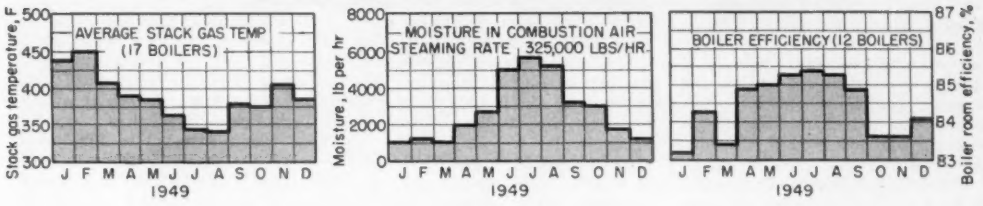
As they saw the problem they had a choice of several courses: Add a reactant to render the product less volatile than the original. Reduce the time or temperature of heating. (For an already installed stoker-fired unit, time of heating could not be materially shortened.) Produce an endothermic reaction (notably the gas-water reaction) in the fuel bed.

The last course had the most appeal. The heat absorbed in the endothermic reaction should be recoverable when the products of the reaction burn. Further, if the burning takes place above the fuel bed, away from the ash, volatilization of any material in the ash should be much less. In addition, some felt the moisture serves as a reactant to decrease volatilization through hydrolysis reactions. Over and above these reasons was another highly interesting one.

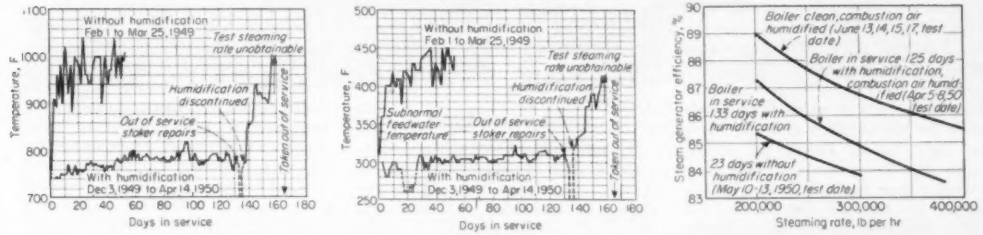
For many years Detroit Edison had been aware of the fact that superheater deposits at Delray formed more rapidly in winter than in summer. In 1944, the possibility was raised that the wetter summer air entering the combustion process might be the influencing factor. So when the all-out investigation of control of fireside deposits was started in 1949 Detroit Edison decided to give this possibility a thorough study. With data from the U.S. Weather Bureau the amount of water vapor per hour entering with the air was figured out. And the monthly average was plotted along with corresponding average air preheater outlet gas temperature for the seven stoker-fired boilers in the plant and the average of the entire boiler-room efficiency. The latter takes in five other boilers operating at a lower pressure and temperature, 400 psig and 700 F, see "Amount of Moisture . . . on Efficiency," top of p 73. The correlation was striking.

Humidification Test. Rather than figure out the extent of any possible water-gas reaction it was decided to put one of the stoker-fired boilers under controlled test conditions. The selected boiler, No. 7, with a close spacing (3.3 in. center to center) between front superheater tubes usually experienced a deposit build-up there that reached shutdown proportions within an average of 50 days or so. The only preparation the boiler had for the test was a routine

AMOUNT OF MOISTURE BEARS ON GAS TEMPERATURES, EFFICIENCY


Stack gas temperature, F
AVERAGE STACK GAS TEMP (17 BOILERS)
Moisture, lb per hr
MOISTURE IN COMBUSTION AIR—STEAMING RATE, 325,000 LBS/HR
BOILER EFFICIENCY (12 BOILERS)
Boiler room efficiency, %
J F M A M J J A S O N D
1949

THESE RESULTS SHOW OPERATING ADVANTAGES


Without humidification Feb 1 to Mar 25, 1949
Test steaming rate unobtainable
Humidification discontinued
Out of service stoker repairs
Taken out of service
With humidification Dec 3, 1949 to Apr 14, 1950
Temperature, F
Days in service
Subnormal feedwater temperature
Steam generator efficiency, %
Boiler clean, combustion air humidified (June 13, 14, 15, 17, test date)
Boiler in service 125 days with humidification, combustion air humidified (Apr 5-8, 50 test date)
Boiler in service 139 days with humidification
23 days without humidification (May 10-13, 1950, test date)
Steaming rate, lb per hr

1 Stack gas up 10 F in 133 days with humidified air; 150 F in 53 without

2 Outlet gas rose only 50 F with humidified air; 220 F without it in 5 days

3 Efficiency checks show higher boiler efficiency using humidified air

RECOMMENDED CONTROLS OVER FIRESIDE DEPOSITS

1 **When unit is shut down, clean all heating surfaces thoroughly, as follows:**
Steam-soak and steam-ammonia-soak to loosen deposits first (British Boiler Availability Committee).
Alkali water-wash, scrape, sand blast. (Detroit Edison Co, Narragansett Electric Co; POWER, Jan 1950, p 93.)
Alkali water-wash with wetting agent (Duquesne Light Co).

2 **Select fuels for low volatilization of alkali salts**
Burn only coals with low concentrations of alkali halides and chlorides (British Boiler Avail. Com.). Note: Delray coals met specification very easily; were also low in sulfur, phosphorus

3 **Hold fuel-bed temperatures low—that is, minimize volatilization as follows:**
Suggest a low firing rate—40-lb-per-sq-ft grate area. Note: The Delray coals burn at a rate from 56-72 lb per sq ft.

4 **Minimize catalysis of sulfur dioxide to sulfur trioxide (W F Harlow):**
Limit temperatures of heating surfaces.
Coat boiler metal with noncatalytic surface—that is, films of Fe_2O_3, lime, soda, carbon, aluminum, pulverized-fuel flyash (Delray found this relief only temporary).

---

scraping and alkali-water wash but no sand blasting. Amount of moisture to enter with the combustion air was arbitrarily set at 7460 lb per hr for a steaming rate of 325,000 lb per hr, about 16.4 lb per 1000 lb of dry air. This roughly equals the highest absolute humidity conditions found in the Weather Bureau data for the summer period at Delray.

Shortly after a second steam-generator, No. 10, with the same rating and firing method as No. 7, except for occasional blast-furnace gas burning, was put under a similar humidification test. This second unit permitted studying variables of operation without jeopardizing the long-time run on No. 7.

Results. Fig. 1-3 show the effects of humidification on No. 7's performance. Because moisture in atmospheric air changes rapidly, the amount to be added had to be flexible. At Delray it was introduced into the preheated air as saturated steam and adjusted for each 25,000 lb change in steaming rate. Other methods of humidification are under study. See "What Others Say," p 74.

Fig. 3 gives results of several efficiency checks as labeled. They include the charge for stoker and for power requirements but not for humidification costs. At the time of report humidification needs were put at 1.3% of the steaming rate as an average for an entire year and about 2% for the coldest part of the winter.

Top curve of Fig. 3 is considered representative. The center curve is felt to be low because: (1) heating surfaces of waterwalls, boiler, superheater were not well cleaned before the run (2) total carbon in the stack was unusually high. Bottom curve seems too high to be typical. Perhaps because the superheater was fouled to some extent during the 133-day humidification run and the economizer was remarkably clean, the superheater experienced a very heavy build-up of materials that would normally have settled out on the economizer and air preheater once the humidification was shut off. Result is a lower air-preheater-outlet flue-gas temperature than normal and an abnormally high efficiency.

Test Variables. How does humidification compare with some other variables that might influence deposit build-up? From probe samples and results, Fig. 1, 2, 3, rate of deposition runs much less under humidification than without it for almost all conditions of operation. In fact, except for banking periods the nonhumidified unit never did get below the humidified one oper-

ating under a normal 350,000-lb-per-hr load. And this includes probe samples taken from the nonhumidified unit under conditions of different steam output rates within the normal range, rapid changes in steam output, grinding and dumping ash, different-thickness fuel beds, use or not of blast-furnace gas as an auxiliary fuel—studied as possible contributory factors.

Humidification Degree. With results as good as those indicated the question arose of how much humidification would prove best? Samples were collected for runs using an air carrying 4000 lb per hr of moisture, 7460 (the arbitrary figure used for 133 days on No. 7 boiler) and 12,000. These samples indicated that the more moisture, the better the results. What's more the deposit changed in color from nearly white for low humidity to nearly black for high. Yet at Delray the feeling exists that the amount of moisture is probably near the 16.4 lb per 1000 lb of dry air used on the 133-day test rather than the highest figure in the tests just described.

Nature of Deposits. Because one of the prime objectives of the test was to minimize volatilization of alkali salts every effort was made to check the effect of humidification on sodium and potassium compounds volatilized as halides or oxides or carried to the tubes mechanically. The most striking result was a marked decrease in the amount of SiO_2 in the deposits. Humidification also decreases nearly all other noncarbonaceous constituents but not to the extent that it does silicon compounds.

Amounts of Al_2O_3 and Fe_2O_3 drop off slightly in the superheater region but appear nearly independent of humidification in the economizer and air preheater. The total amount of carbon depositing on the several heating surfaces is obscure as far as humidification goes. It seems that firing conditions play a much larger part. But total soluble deposits, in general, diminish with humidification.

OTHER EXPERIENCES

When the Delray experiment became known at least one other utility decided to run independent tests. They employed a combustion air containing 16.4 lb of moisture per 1000 lb of dry air. Preliminary results were so good they equipped 13 steam generators with humidification equipment. These units range in size from ones with 45,000-lb-per-hr capacity and 127 sq ft of grate area to a single steam generator of 370,000 lb per hr, 730-sq-ft grate area.

Before humidification one station of this operating company scheduled a weekend 2-day shutdown every six weeks for stoker maintenance and heater surface cleaning. It took about 150 man-days per outage, half of it at overtime, and around 500 to 700 stoker castings to maintain the stoker. Loss in steam-generating capacity from fouled heating surfaces reached as high as 10% of the maximum clean-condition capacity. Economy loss ran 2% or more.

Early Results. With about five months' operation at the time of this report results seem very encouraging. Savings from reduction in dry-gas heat loss due to lower stack-gas temperatures is greater than the cost of steam for humidification. Steaming capacities stay very close to those under clean boiler conditions. Steam-generator outage for stoker maintenance has been reduced 50% (12 weeks' running time against 6 previously); stoker iron replacement down 50% (about the same iron required for 12-week period as in 6 previously). Labor per outage is 60 man-days against a former 150 days—a reduction of 60%. Estimated labor saving for cleaning surfaces (no actual data reported) has been set as close to 80-85%.

WHAT OTHERS SAY ABOUT HUMIDIFYING STOKER AIR . . .

W F HARLOW, Member, Institute of Mech Engrs, London, Eng.:

Paper shows conclusively that a remarkable reduction in flue-gas deposits has been effected. Quite apart from any thermal efficiency gain is the noteworthy improvement in availability from 53 to 133 days.

It's quite clear fuel quality is not the dominant factor in this problem, as so often thought.

Sulfur trioxide formation seems to have been definitely suppressed and is the fundamental reason for the reported improvements rather than the intended reduction of volatilization of alkali salts.

Surface temperature of superheater tubes has apparently been greatly lowered, probably because humidification improved the combustion process. This lower temperature has more to do with reduced sulfur trioxide formation than would a lower fuel-bed temperature, in Harlow's opinion. As evidence he cites the similar problem in pulverized coal and oil-fired boilers.

BOILER AVAILABILITY COMMITTEE, Great Britain:

Experiments on two retort-stoker-fired boilers have been carried out in England with recirculation of flue-gas with the air supply to improve the combustion process. Results are spectacular. Introduction of auxiliary pulverized-fuel firing, 10% of fuel burned, above the bed, plus advocated cleaning methods, improved availability from 600 hr to 1200-1400 with some water lancing. With gas recirculation (about 10%) availability went up to 4500 hr with no change in character of deposits and practically no water lancing employed at all.

Gas recirculation has more to commend it than steam injection. It is cheaper and superimposes an endothermic reaction between fuel bed and CO_2 on those with steam.

R B DONWORTH, Member, ASME, Pittsburgh:

Rate of steam use for humidification appears to be about 1½%. Why not humidify by direct evaporation by the forced-draft fan? In extremely cold weather this evaporation will pull forced-draft air temperature down to 75 F. Since 115 grains per lb of dry air represents 100% relative humidity at 71 F, you will have to preheat air to at least 146 F before humidifying, or add the equivalent heat during humidification. But to get complete and effective evaporation you may have to add even more water and remove the surplus in an air separator, as some air washers do.

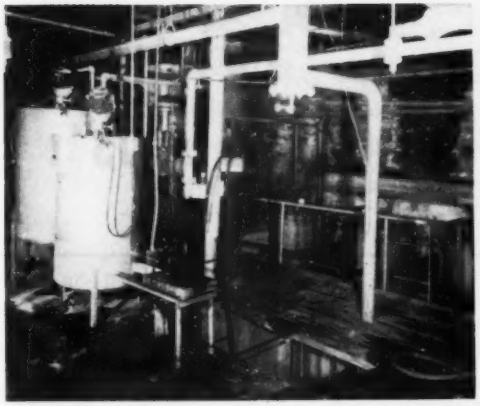
You could recirculate some boiler outlet gas, and overcome the difference in draft by mechanical means. Since steam is to be added anyway, it is logical to use an injector for humidification. Gas recirculation runs about 8% of air flow for a 325,000-lb-per-hr boiler.

R A SHERMAN, Battelle Memorial Institute:

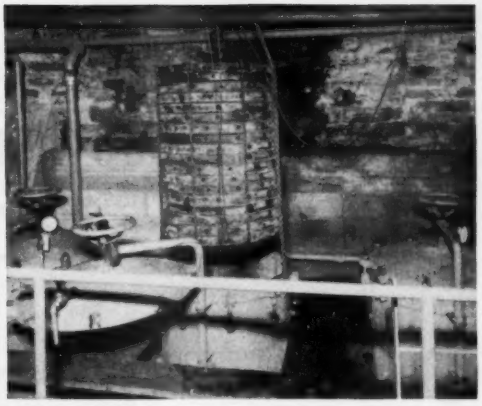
Use of steam to control slag formation and clinkering in fuel beds of gas producers has been the practice for years.

The simple explanation of the endothermic reaction of water with carbon is that carbon monoxide and hydrogen form with a resulting lowering of temperature. Haslam and others, though, say no hydrogen is found until all oxygen of the air is gone. If the endothermic reaction takes place it is above the oxidizing zone where fuel-bed cooling is needed.

But the steam can react at the surface of the carbon and absorb heat. Hydrogen and carbon monoxide, however, oxidize immediately as they pass into the spaces between the fuel pieces. This is similar to today's conception of oxygen and carbon reaction where nothing but CO_2 forms until no O_2 is left when carbon monoxide forms. Just how this would affect temperature is a little hard to see.



1 FILTER STATION. Precoat and slurry tanks, *at left*, three filters, *right*. Turbulator is vertical cylinder, *top center*

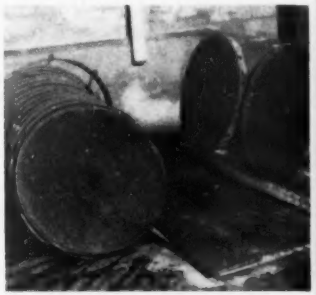


2 LEAF ASSEMBLY of one filter tank is being removed with an electric hoist. Setup reduces cleaning time and labor

Oil in condensate and exhaust plagues many steam-engine and process plants. This firm found a sure-fire, thrifty solution for the problem. Read how their . . .

Low-Cost Filters Chase Oil From Condensate

By I L PLUMMER, *Chemist*, and J H PEEBLES, *Chief Engineer*
The B F Nelson Manufacturing Company



3 FILTER LEAVES ready for washing with water hose. Leaves good for 70 hr

►WE FOUND ELECTRIC DRIVES for production equipment cheaper than steam at The B F Nelson Manufacturing Co,* Minneapolis, Minn. So expansion of power facilities, begun in 1946, featured 425-psi boilers and turbine-generators. Steam extracted at 50 psi supplies process; condensate is returned to boilers. But oil in condensate posed big problem in plant expansion. Here's what we met.

Old Plant. Three steam engines used 150-psi steam from old boilers, exhausted to 45-psi process. All process condensate was returned to boilers. We knew there was oil in the condensate, and first step was to find how much and in what form, free or emulsified. Steam engines, wash tanks and wash rooms were major sources of the oil.

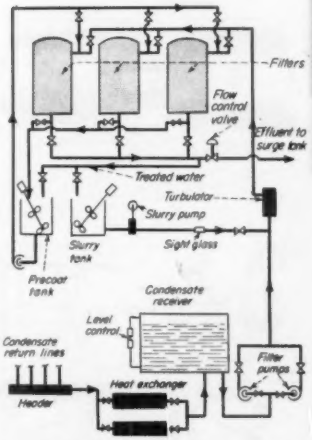
*Manufacturers of asphalt shingles, roll and built-up roofing, building papers, fiber containers, dry felt and paperboard mill products, and many others.

Tests showed highest oil concentration in boilers was 87 ppm; lowest, 47 ppm; 65 ppm, average. Concentration in two condensate receivers ran 33.4 ppm, mostly emulsified. About 50% of boiler feed was condensate. Oil had to be kept out of the new boilers so we quickly tackled the problem.

Oil separators in condensate line and an overflowing and open feed heater removed appreciable amounts of oil. Feeding chemicals to old boilers and blowdown adjustment improved steaming conditions; but we found that emulsified oil was prevented from coalescing by absorption in dirt and precipitate in boilers.

Oil Removal. Since we weren't certain which filtering equipment could do best job for us we installed pilot plants of several pressure-filter types during construction of new plant. In addition,

(*Continued on page* 196)

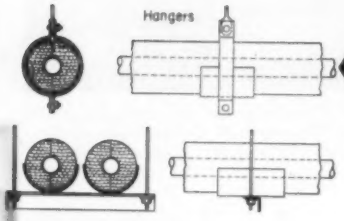


4 FLOW DIAGRAM of filter installation shows major components used in plant

Insulation Handbook: Part 7

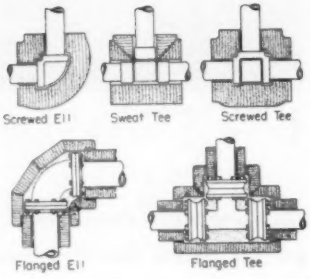
How to Use Cork for Cold Jobs

By PHIL SWAIN, *Editor*



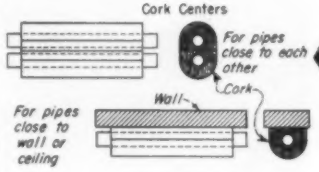
PIPE HANGERS

Must be outside of covering, not touching pipe. Frost collects on hanger rod connected to pipe. Use 12- to 18-gage shield between hanger and covering



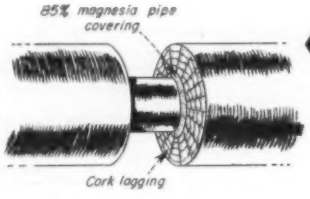
PIPE FITTINGS

Apply screwed-fitting covers before pipe covering; reverse for flanged lines. Use waterproof cement on joints; secure screwed-fitting covers with four copper-clad wires or galvanized bands, six on flanged lines. Fill voids with paraffin and cork filler; put seam filler in seams and chipped edges. Finish with canvas, tape or paint



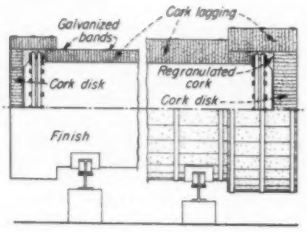
CORK CENTERS

Use where pipes are too close to each other, to walls or ceiling surfaces for regular pipe covering



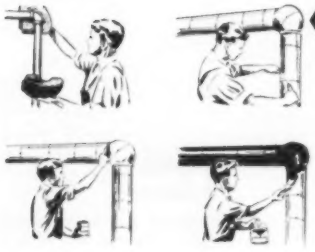
DUAL COVERING

For 200 F to −75 F, inner layer is standard thickness 85% magnesia, outer seven inches of cork. Finish applied over cork. Other arrangements are used for different temperature ranges



SMALL TANKS

Single-layer cork lagging and disks cut to fit tanks under 54-in. dia. Stagger joints; glue with waterproof cement. Extend body or flange lags to cover disks. Put cork or filler in voids

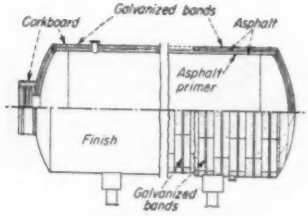


COLD PIPES

Have line tight, clean, dry. Cut 36-in. length of cork in half; fit half section and full length. Continue with 36-in. lengths. Use waterproof cement on joints; put seam filler in seams and chipped places. Wire cork in place with six copper-clad wires or bands per length. Finish

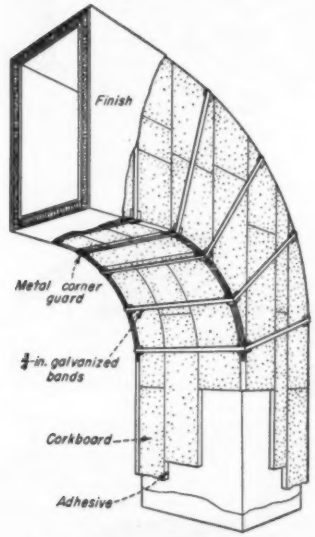
Note: Where cork type is not given in text it is shown on drawing.

Here's the story on cork insulation for low-temperature jobs. Compiled from authoritative sources, drawings and condensed instructions summarize usual procedures in refrigeration, cold storage and other low-temperature plants. Use them today



LARGE TANKS

Use corkboard on tanks over 54-in. dia. Prime tank with asphalt paint. Score, bend cork to fit. Apply in hot asphalt, waterproof cement or adhesive. Band on 12-in. centers. Fit other layers same way with skewers, bands

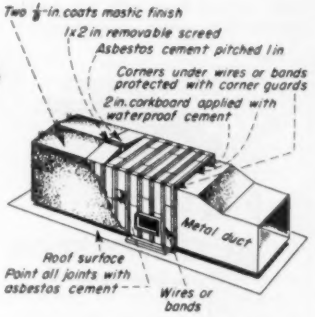


AIR-CONDITIONING DUCTS

Clean. Adhesive, hot asphalt or fasteners, bands and wires hold cork. Finish indoor ducts with plaster, canvas or asphalt emulsion. Leave returns bare when supply ducts are short, temperature low

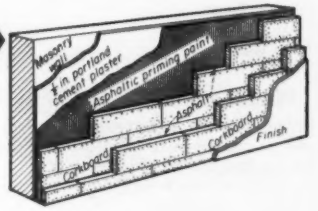
OUTSIDE DUCTS

Glue cork to duct with waterproof cement. Bind with metal bands or copper-clad wires; corner angles protect cork. Point joints; build watershed; finish


Two ⅛-in. coats mastic finish
1x2 in removable screed
Asbestos cement pitched 1 in
Corners under wires or bands protected with corner guards
2 in. corkboard applied with waterproof cement
Metal duct
Roof surface
Point all joints with asbestos cement
Wires or bands

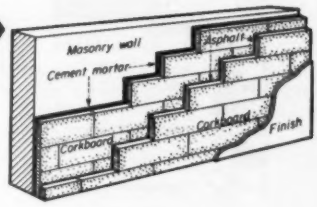
MASONRY WALLS: I

Clean; plaster; prime when dry. Apply first and second layers cork in hot asphalt. Secure second to first with treated hardwood skewers. Finish



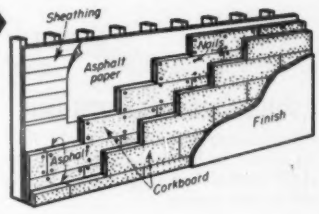
MASONRY WALLS: II

Clean; roughen; apply first layer cork in ½-in. portland-cement mortar. Use hot asphalt and hardwood skewers for second layer. Finish



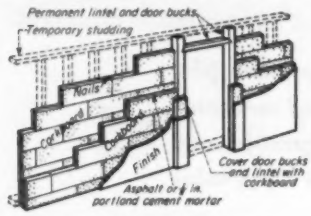
WOODEN WALLS

Tack asphalt paper to wood; lap edges. Nail first layer cork to wood; use hot asphalt under cork. Apply second layer with hot asphalt and skewers. Finish



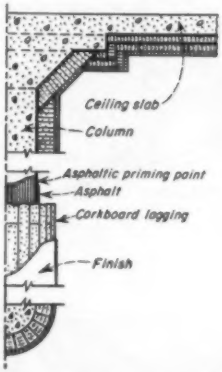
MORE ON NEXT PAGE

CORK FOR COLD JOBS continued



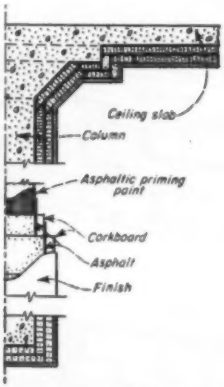
SOLID CORKBOARD WALL

Erect temporary studs. Mount first layer cork against studs; toenail butting boards; also nail to ceiling, floor, walls. Apply second layer with hot asphalt, skewers. Use portland-cement finish



ROUND CONCRETE COLUMN

Prime concrete surfaces; fit beveled cork to column in hot asphalt. Toenail butting boards with skewers. Finish

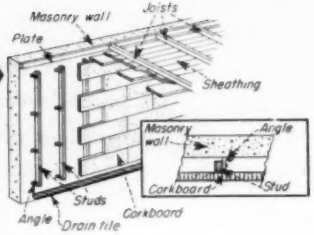


SQUARE CONCRETE COLUMN

Prime concrete surfaces; apply first layer cork in hot asphalt. Use hot asphalt, wooden skewers for second. Finish and protect corners

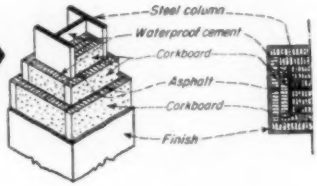
BELOW-GRADE WALL

Where seepage can't be stopped externally, put heavy coats back-plaster and asphalt on inside of wall. Leave air space. Nail asphalt-coated cork to studs. Finish



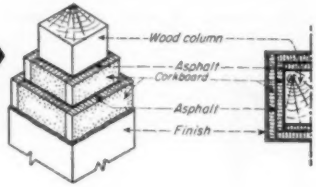
STEEL COLUMN

Clean; glue cork to steel with waterproof cement. Fill web spaces. Use hot asphalt, skewers for other layers. Finish and protect corners



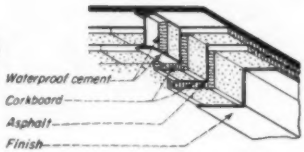
WOODEN COLUMN

Prime wood with asphalt paint. Apply first layer cork in hot asphalt; nail to column. Use skewers, asphalt for second layer. Finish and protect corners



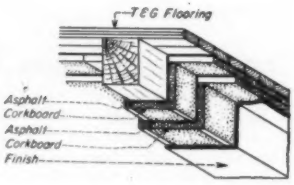
STEEL BEAM

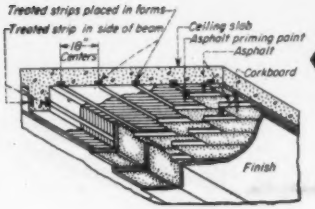
Clean; glue first layer to steel beam with waterproof cement. Use hot asphalt and skewers for other layers. Finish



WOODEN BEAM

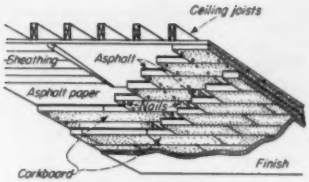
Prime with asphalt paint. Use hot asphalt, nails for first layer cork; hot asphalt, skewers for second. Finish





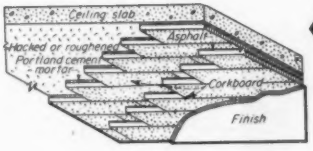
SLAB WITH WOOD STRIPS

Clean, prime. Use hot asphalt, nails for first layer. Nail cork to wood strips. Use hot asphalt, skewers for second layer. Finish



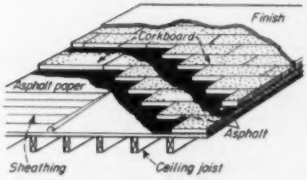
WOODEN CEILING

Tack asphalt paper to underside of wood. Lap edges. Use hot asphalt, nails and skewers to secure cork. Finish



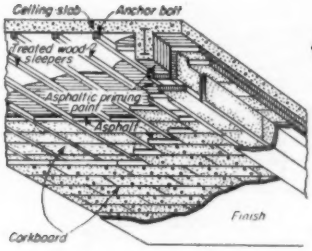
CONCRETE SLAB

Clean, roughen or hack; wet. Apply first layer cork in portland-cement mortar. Prop in place. Use hot asphalt, skewers on second. Finish



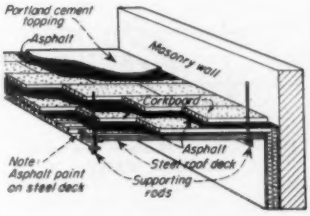
WOODEN ROOF DECK, CEILING

Leave slot 1 in. wider than wall insulation along all walls. Tack paper to wood; lap all edges; seal with hot asphalt. Lay cork in asphalt; flood with it



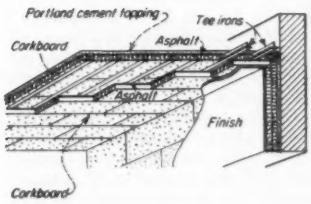
CONCRETE CEILING

Anchor sleepers to slab on 12- or 18-in. centers. Clean slab; prime. Apply first layer with hot asphalt and nails; second with hot asphalt, skewers. Finish



STEEL DECK, CEILING

Leave slot for wall insulation. Prime steel deck with asphalt paint. Set special cork fillers between flanges. Lay cork in hot asphalt; flood with it

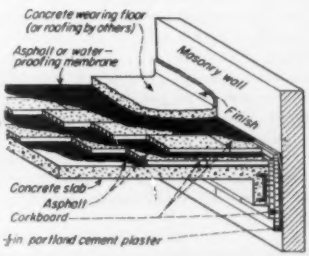


T-IRON CEILING

Space tees 12 or 18 in. Notch first layer cork to fit flanges. Flood top with hot asphalt. Apply 1-in. cement. Use asphalt, skewers on second layer

CONCRETE ROOF, CEILING

Leave slot for wall insulation. Apply cork directly to concrete, laying in and flooding with hot asphalt. Finish



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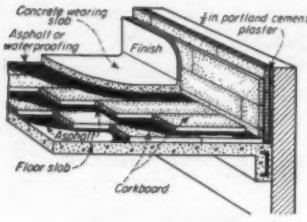
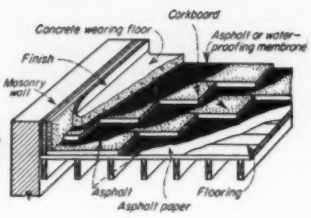
CORK FOR COLD JOBS continued



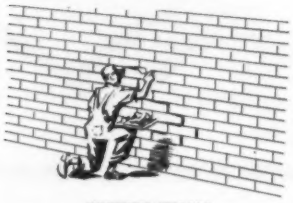
CONCRETE FLOOR

Dry; have floor smooth, level. Lay in hot asphalt and flood cork with it. Pour concrete wearing floor



WOOD FLOOR

Lay asphalt paper on wood. Lap edges. Seal with hot asphalt. Lay cork in hot asphalt and flood with it. Finish

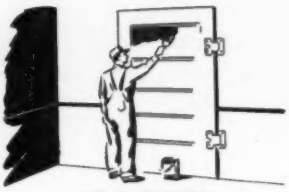


OUTSIDE WALLS

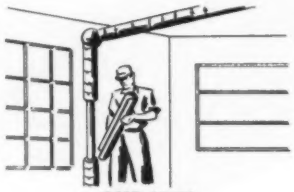
INTERIOR WALLS

MAINTENANCE

Once your insulation is in, treat it well. Exterior Walls. Check regularly for cracks or flaws. Point joints when needed. Masonry walls usually require some pointing every year to keep in top condition. Interior Walls. Patch cracks and chips as soon as they appear. Use asphalt emulsion or seam filler. Roofs. Examine often. Repair leaks at once. Closely watch parapets and junctions with vertical walls. Wood Fixtures. Paint at least every year with one coat odorless paint. Doors. Check alignment; replace hard or flat gaskets. Tighten hardware; replace damaged parts. Check wooden parts for rotting. Cold Pipes. Inspect often; patch cracks and chips. Replace loose wires and damaged sections. Give good coat of cork covering paint. Loose insulation in good condition can be dried out and installed again, if desired. Follow manufacturer's instructions for your job



WOOD FIXTURES



COLD LINES

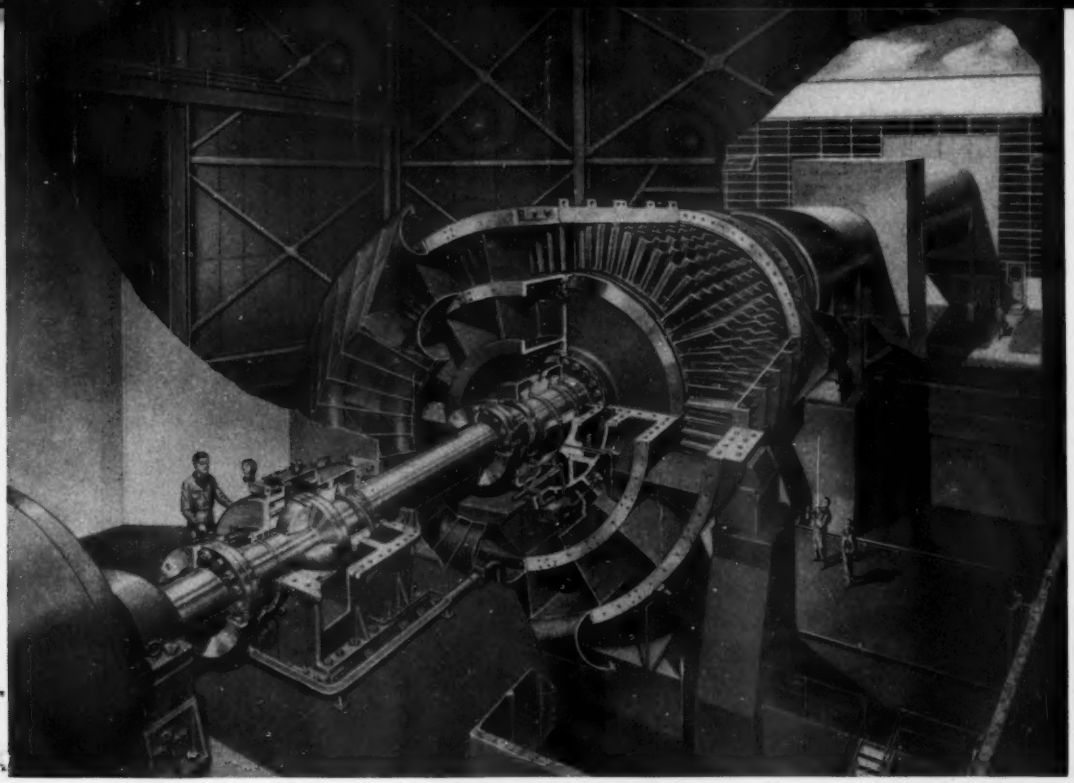
Quick Facts on Cork Insulation

► CORK HAS 200-million cells in every cubic inch of material. Each cell is a 14-sided geometric shape filled with still air. This trapped air acts as a barrier to heat flow, makes cork an efficient insulator. Cells fit together so well there's no space between them where moisture can collect. Nor can it penetrate the tough, resinous cell walls. Cork isn't capillary.

Forms. Corkboard, cork pipe covering, lagging and disks are of most interest to power and refrigeration engineers. Corkboard is made of carefully sized cork granules, compressed and baked into board form. Standard board has no finish; special has factory-applied asphalt on both faces or ⅛-in. asphalt mastic finish on one face. K is 0.27 Btu per bd ft per hr per deg F at 60 F mean temperature. Sizes range from 12 to 36 in. wide by 36 in. long, 1 to 6 in. thick. Weight is 0.55 to 0.65 lb per bd ft.

Pipe and fitting covering comes in three standard thicknesses: *heavy duty*, 2.63 to 4 in. thick for cold lines from 0 to −25 F; *standard thickness*, 1.70 to 3 in. thick for 0 to 35 F; *light duty*, 1.2 to 1.39 in. thick for 35 F and above. All three thicknesses made to fit standard pipe and copper tubing from ¼ in. up. Furnished in 36-in. lengths.

Lagging and disks are coated inside and out with asphalt mastic finish. Made 1½ in. to 6 in. thick. Have same physical characteristics as corkboard. Lagging supplied cut to proper length and beveled for the equipment if you furnish cork supplier with job drawings.



SUPERSONIC WIND. Most powerful axial-flow air compressor. It runs at 860 rpm, is about 20 ft long by 20 ft dia, weighs nearly 900,000 lb. Capacity 2,200,000 cfm. Three 29,000-hp wound-rotor motors drive it. *Photo, courtesy Socony-Vacuum Co.*

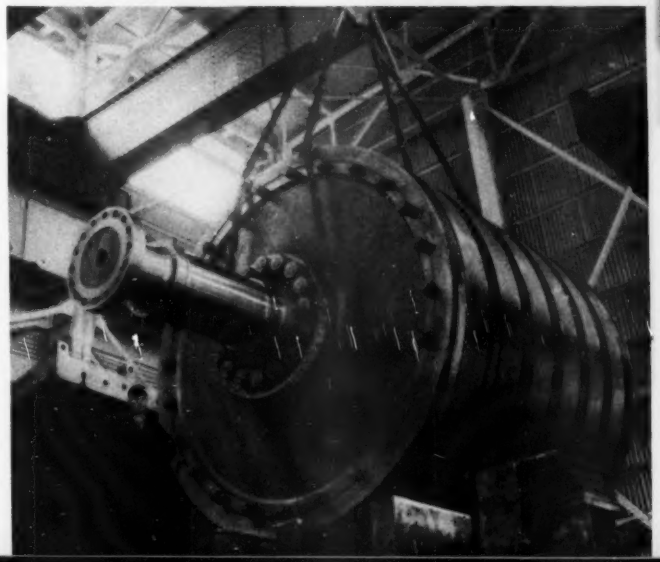
100,000-Horsepower Wind Maker

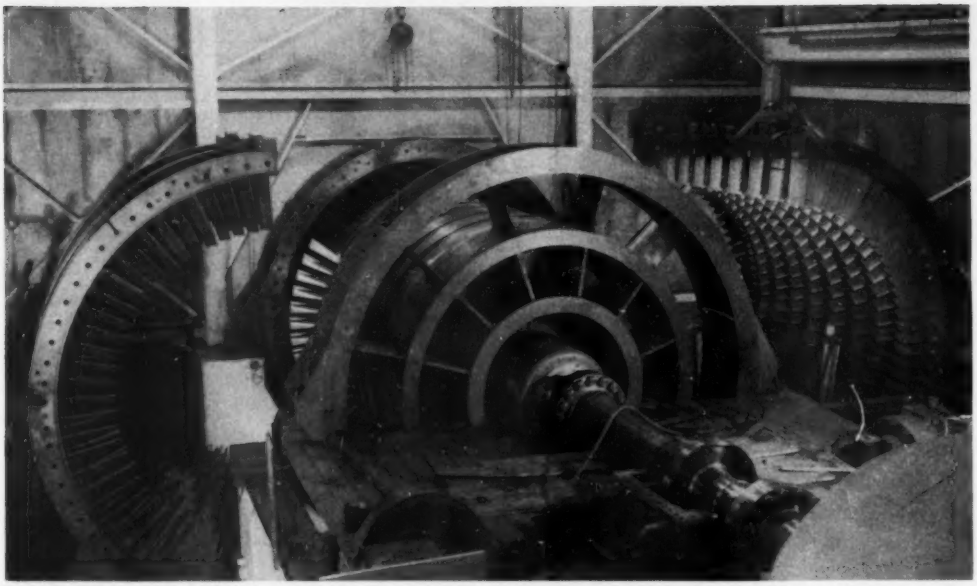
►As AIRPLANE SPEEDS go beyond the speed of sound, higher air velocities are needed in wind tunnels for research testing. Producing these velocities requires tremendous blower capacity and power.

An outstanding example is the world's most powerful axial-flow air compressor installed at the Lewis Flight Propulsion Laboratory of the National Advisory Committee for Aeronautics in Cleveland. This compressor, built by S Morgan Smith Co, can handle up to 2,200,000 cfm of air to produce wind velocities up to 1500 ft per min in the tunnel test section. At full-rated capacity and 860 rpm, the compressor requires nearly 100,000 hp to drive it, supplied by three General Electric wound-rotor motors (see POWER, p 102, Sept 1950).

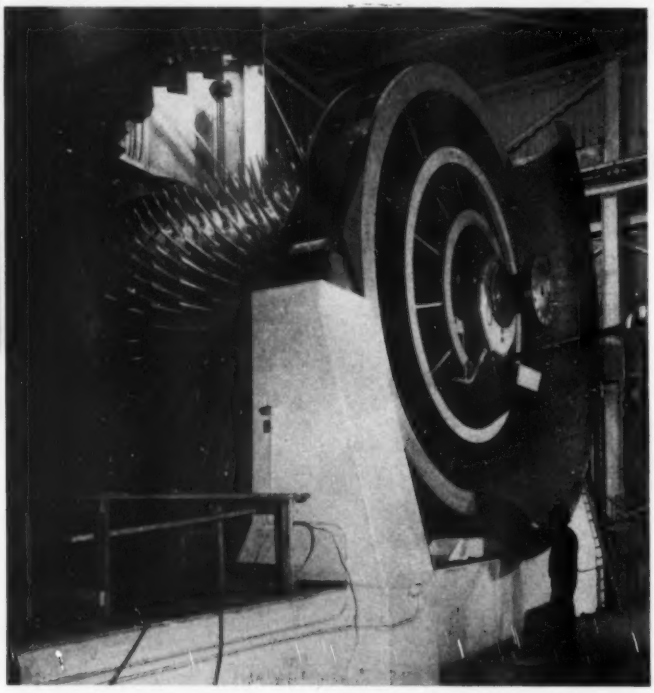
Because of the large power requirements of the compressor, highest possible efficiency was of paramount importance. NACA, who took care of the

ROTOR WITHOUT BLADES. Compressor rotor with shaft, assembled of 13 solid forged-steel disks, and spacer rings, is held together with heavy-steel through bolts





COMPRESSOR CASING OPEN. Casing is split vertically along its center line parallel with shaft, with the halves bolted together. Before opening compressor, four wheels are jacked down on a track to support casing while moving halves apart



COMPRESSOR INTAKE. The compressor's end supports have an inner ring to carry the bearings. These, in turn, are supported in the outer rings by radial struts

aerodynamic design of the compressor, report exceptionally fine results on field test. Top photo (p 81) shows sectional view through the compressor connected to the wind tunnel. It is about 20 ft dia. by 20 ft long, weighs nearly 900,000 lb.

Two stationary end sections support the casing between them. Casing is split on its vertical center line and held together with bolts. About 600 stationary blades are distributed in nine rows. Before opening compressor for inspection four wheels are jacked down on tracks to support each half of casing.

Rotor is built up of seven steel disks and six spacers, bolted together. End disks are flanged for bolting to the shaft flange. Each disk was a solid steel forging about 13 ft dia by 18 in. thick for the two end disks, with center ones 13 in. thick. Each end disk weighs about 60,000 lb, the center ones less.

Compressor blades were milled from rectangular aluminum forgings on profiling machines. Two of these machines worked 24 hr a day for many months to finish the 1100 blades in the compressor.

Stator blades have a round, tapered shank turned in a lathe. Holes and counterbores for these blades in the casing were accurately drilled and reamed for both location and angle with compressor's center line. Although the pitch angle is adjustable, calculations and initial setting were such that expected performance was obtained without resetting any blades.

Motor-Reversal Problem? ...Here Are 9 Solutions

Changing a motor's direction of rotation is often a problem when designing a new drive or when adapting an old motor to a new job. The procedure varies depending on motor type

By J L WATTS, *Engineer, Southampton, England*

► IT IS A RELATIVELY simple matter to reverse most electric motors. But before considering each motor type let us review some of the general principles that influence motor reversal.

Dc Motors. Torque developed by any dc motor is a function of the flux in main magnetic field and current in the armature conductors. In general, these motors may be reversed by changing the direction of the flow of current in either the main field or armature. But if a dc machine is used at times as a motor, and at other times as a generator, it is wisest to use the same magnetic-field polarity in both cases. Otherwise when operating as a generator it may have lost its residual magnetism and hence fail to build up. This would necessitate flashing the field from an outside source of dc.

Some brush shifting may be necessary to avoid sparking after reversing a motor that has no commutating field. Consequently commutating poles are generally used on all dc motors that are frequently reversed.

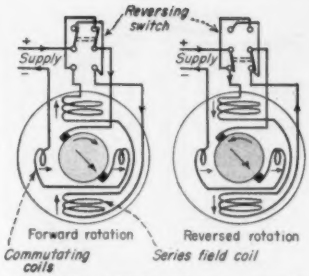
Polarity of a commutating pole should be opposite that of the next main pole in the direction of rotation. If the motor is reversed by reversal of field current, polarity of commutating poles should remain unchanged to maintain the correct commutating field. To hold this polarity relationship between commutating and main field poles consider the armature and commutating poles as one unit. Hence when reversing rotation by changing the direction of armature current, reverse current flow through commutating field. As a rule of thumb, don't break the connection between armature and commutating field unless reversal is made by moving brushes through one pole pitch.

After Reversal. Brushes on some motors are not set radially to the commutator. Hence they may tend to chatter after reversal. Often this can be corrected by reversing the brush holders on their rigging. This change in brush holders may also mean shifting brush gear to hit the neutral position. And after reversing, check that the oil ring is turning freely in the new direction.

Plugging. The term plugging signifies reversing the applied voltage—or phase rotation for ac motors—to bring motor to a fast stop. When a dc motor is plugged, it is necessary to reverse the armature polarity and introduce resistance in series with the armature to limit the flow of current. The additional stress on armatures subjected to frequent reversal is considered at the drawing-board stage. This added stress is brought about by momentum of the drive moving armature in one direction while armature conductors are exerting a braking torque in opposite direction. Relays are available for use with motors subject to plugging duty; they will open the main feed to the unit before motor completes one turn in opposite direction.

Certain types of ac motors, such as 2- and 3-phase induction, may be used for plugging duty. Wound-rotor induction motors usually have resistors inserted in the secondary circuit at instant of plugging. Aim here is to limit primary current and yet get maximum value of plugging torque. Split-phase motors equipped with a centrifugal switch can be plugged by switching only after slowing down to the point where centrifugal switch in auxiliary winding closes.

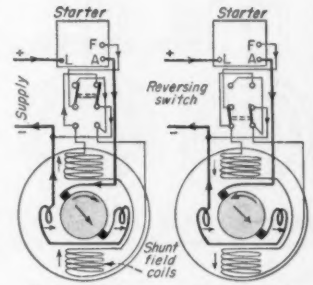
Now scan the nine cases covered on this page and following three pages:



CONSIDER ARMATURE, commutating field as one unit to prevent bucking fields

1 REVERSAL OF SERIES MOTOR BY SWAPPING FIELD LEADS

In some small series motors the armature is connected directly between two sections of field windings. Reverse such motors by simply reversing direction of armature current flow. And if brush leads are long enough, armature current may be reversed by simply moving the whole brush rigging around through one pole pitch. But if motor has no commutating poles, brushes are usually set slightly back from neutral position to aid in commutation. Hence if brushes are moved opposite to direction of original rotation, move them less than one pole pitch. On the other hand, if brushes are moved in same direction as original rotation, a greater shift may be required. Brushes spark if set out of proper position.

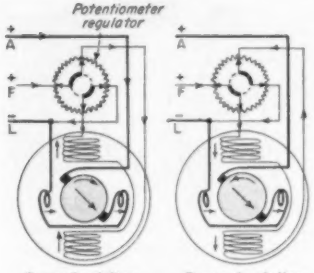


CIRCUIT BREAKER trips on starting if the field reversing switch is left open

2 SHUNT MOTOR REVERSED BY DOUBLE-POLE SWITCH

Shunt motors are generally reversed by switching the shunt field leads. This can be handled by inserting a double-pole double-throw switch in the shunt field circuit. Machine may also be reversed by swapping leads feeding armature and commutating poles. Latter method requires heavier reversing switch be used.

Continued on Next Page

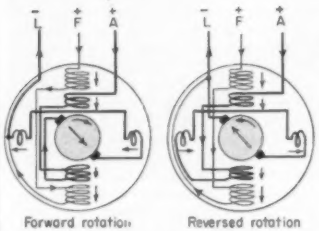


SHUNT MOTOR HOOKUP with potentiometer doubling as discharge resistor

2A MORE ABOUT REVERSING SHUNT MOTORS

When a reversing switch is used, care must be taken not to interrupt the field coil connections until the coils have discharged through the armature or a separate discharge resistor. If not, a high voltage may be induced in the coils and damage the insulation.

When reversing any shunt or compound motor (by changing leads manually), consider the armature and shunt field as two separate circuits. This means opening the common connection between armature and shunt when swapping leads. The mistake to avoid is swapping one armature lead and the common field and armature joint.

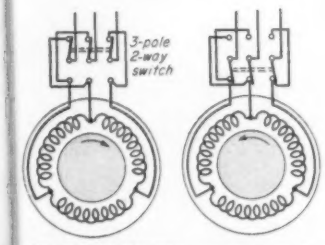


IN ADDITION TO above method, motor reverses if shunt field leads are swapped

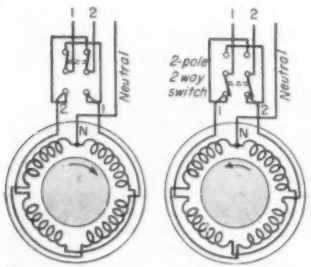
3 INTERCHANGE ARMATURE-CIRCUIT LEADS ON COMPOUND MOTOR

When reversing a compound motor don't change the relative polarities of the shunt and series field coils. This means the connections to the armature and commutating poles as a unit must be reversed or current through the series field and shunt field must be reversed. Otherwise, starting torque, starting current and speed under varying motor load will be altered.

Of course, if convenient the brushes may be moved one pole pitch and the commutating pole connections reversed. But this is generally cumbersome compared to simple armature and commutating field reversal.



INDUCTION MOTOR can be plugged to fast stop by flipping the reversing switch



NEUTRAL CONNECTION is not disturbed when reversing 2-phase 3-wire motor

4 REVERSE ONE PHASE FOR 2- AND 3-PHASE INDUCTION MOTORS

Polyphase induction motors are reversed by changing phase rotation of the revolving magnetic field created by the stator currents. In a 3-phase motor, it simply means two of the three stator leads must be interchanged. This may be handled with a double-pole double-throw switch. But if the same switch is to isolate motor and supply, a 3-pole double-throw switch with off-position is required.

When reversing it is not necessary to alter connections in the rotor circuit of a 3-, 2- or single-phase motor. For a wye-delta starting arrangement, there will be six leads between motor and starter. Hence in such cases, reverse connections on supply side of starter.

Rotor-fed type, 3-phase commutator motors may be reversed by interchanging two of the supply leads. But if brushes are not symmetrical about the neutral point, they may need a shift backward after reversal to insure high starting torque along with good power factor.

An externally started synchronous motor may be reversed by simply starting it in the opposite direction. But a small single-phase synchronous motor with starting winding can be reversed by reversal of current in the starting winding. For a large motor having an auxiliary starting motor, synchronizing connections must be adjusted after reversal.

When a polyphase synchronous motor is reversed, take care the dc field circuit is not disturbed. Synchronous motors are generally started with the field windings connected across a discharge resistor. This resistor is chosen so voltage across field terminals, with the induced field current flowing, will not exceed 1000 or 2000 volts. If field is open-circuited with full stator voltage applied and rotor at standstill, the voltage across the field terminals will often reach and, sometimes, it will exceed 10,000 volts.

5 SPLIT-PHASE: CROSS STARTING- OR MAIN-FIELD LEADS

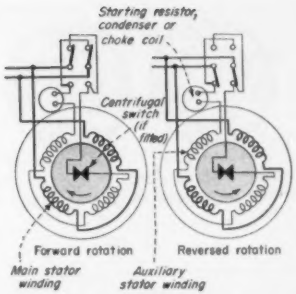
In a single-phase induction motor, either split-phase or capacitor type, the aim is to create an auxiliary flux, out of step with that from the main field. In this way you get in effect the rotating field necessary for starting. This auxiliary field is obtained by using a starting or auxiliary winding so designed that current flow through it is out of phase with that in the main winding.

This same effect can be had to a greater degree by connecting a resistor, choke coil or capacitor in series with this winding. Such motors can be reversed by reversing the current flow in either the main or auxiliary winding. A single-phase motor with open starting winding is not self-starting. But it will run well in either direction once started by external means.

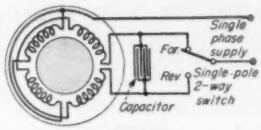
This elementary principle of reversing single-phase motors (by changing direction of current flow through starting or main winding) holds equally well for the plain capacitor motor, the capacitor-start and the 2-value capacitor motor.

The electrically-reversible capacitor motor, shown in middle sketch to right, has two similar stator windings distributed around the stator core. This motor may be started, stopped, or reversed by a simple single-pole, 2-position switch. Motor may also be isolated with the one switch provided it is double-pole, double-throw with an off-position. Note that the motor is reversed by connecting the capacitor in one or the other stator windings.

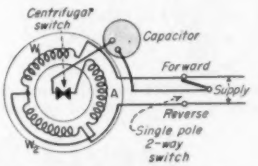
Capacitor-start motor, lowest of three sketches to right, has two similar main stator windings, W_1 and W_2. In addition it has a starting winding, *A*. Winding *A* is used for starting the motor in either direction. However, main winding W_1 is used for starting and running in one direction. Likewise, main winding W_2 comes to the front when starting and running in the other direction. Keep in mind that both windings, W_1 and W_2, are in the circuit regardless of motor's rotation.



AUXILIARY OR STARTING winding open by centrifugal switch after motor starts



DOUBLE-THROW SWITCH picks rotation direction. No centrifugal switch is used



BOTH WINDINGS, main and auxiliary, are symmetrically located and not as shown

6 MECHANICAL REVERSAL OF STATOR IS USUALLY NECESSARY WITH SHADED-POLE UNITS

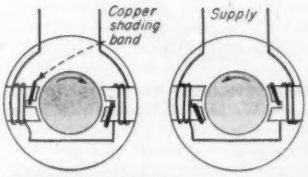
The relatively inefficient shaded-pole motor, generally used to drive small appliance loads like fans, is often the most difficult to reverse. Its operating principle hinges on encircling a section of each pole face with a copper band. This acts as a short-circuited secondary winding delaying the magnetic flux in the encircled portion. Rotor will always turn from the main portion of each pole face toward the encircled portion. So the relative positions of the two portions must be changed to reverse rotation.

Sometimes it may be possible to do this by turning the whole stator core, with its windings, around in the end-shields. In such cases the stator winding and core assembly slips out of the outer shell simplifying reversal. In other motors the same effect can often be obtained by reversing the complete stator with outer shell, leaving the rotor in its same relative position. At any rate reversal of this type shaded-pole motor is a mechanical rather than a purely electrical problem.

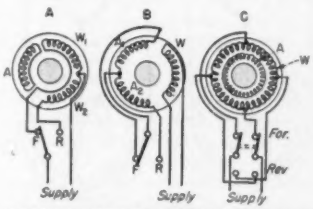
On the other hand, some shaded-pole motors are specially designed with an eye toward reversing by simple switching. Motor *A*, in sketch to right, has a short-circuited stator winding *A* and two separate main stator windings, W_1 and W_2. We can say the motor is "swing" connected since either W_1 or W_2 may be used, depending on whichever portion is required for correct rotation. This type motor can be started, stopped or reversed, but not isolated, with a single-pole double-throw switch.

Motor *B* in this same group of sketches shows connections for a unit with one main- and two auxiliary-stator windings. Direction of rotation is determined by short-circuiting one or the other of the auxiliary windings A_1 or A_2. This type motor, however, needs a separate switch for starting and stopping.

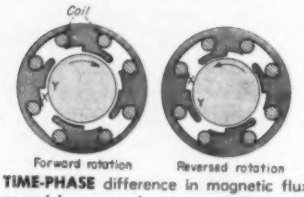
Last motor in this group, C, has its main stator winding in four sections. Auxiliary winding *A* is permanently short-circuited. In reversing rotation current through half of the main stator, winding is reversed.



ROTOR WILL ROTATE from main portion of each pole-face toward encircled part



REVERSING CONNECTIONS for less-common electrically reversed shaded pole



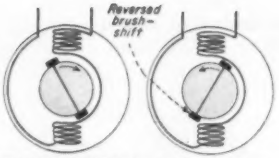
TIME-PHASE difference in magnetic flux caused by unequal air gap at X and Y

7 RELUCTANCE MOTOR: SWAP STATOR MECHANICALLY

Operation of the small reluctance-start motor is similar to that of the simple shaded pole unit, in that reversal is a mechanical rather than an electrical problem. Each pole may be considered divided into two magnetic parts. One part, X, has a large air gap while the other part, Y, has a small air gap. A portion of the flux from the pole crosses the air gap at the wide part, X. And since there is relatively less iron in the circuit, compared to gap Y, flux at X will lead flux at Y in time phase.

Rotor turns in a direction from the large to the small gap, X to Y. Hence, to reverse the motor the relative positions of the two parts of the poles must be changed, as for the simple shaded motor.

8 REPULSION UNITS: SHIFTING BRUSHES ON COMMUTATOR IS OFTEN THE ANSWER

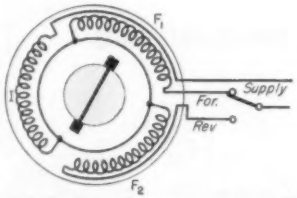


BRUSH POSITION for both directions of rotation is generally marked on machine

Stator winding of the repulsion motor is fed directly from the supply. There are three types of repulsion motor: plain repulsion, repulsion-induction and repulsion-start-induction. Each motor has a wound rotor similar to that of a dc armature. This winding connects to a commutator on which are brushes that are short-circuited. Often this short-circuiting bond is not insulated from the motor frame.

In addition to the above, the repulsion-induction motor has a short-circuited cage winding on the rotor. This is generally beneath the insulated winding. On the other hand, the repulsion-start-induction motor has no cage winding. Instead it has a centrifugal device that short-circuits the commutator when the motor has accelerated to a certain critical speed on starting. Frequently this short-circuiting device raises the brushes from the commutator to reduce wear.

All the above repulsion motors can be reversed by moving the brushes slightly around the commutator as indicated in accompanying sketches. Generally the brush position for both directions of rotation is marked on the machine. No physical change in connections is necessary in the above motors. But there are some repulsion motors that have a compensating winding on the stator. When such motors are reversed by brush movement the leads to the compensating winding should be reversed.



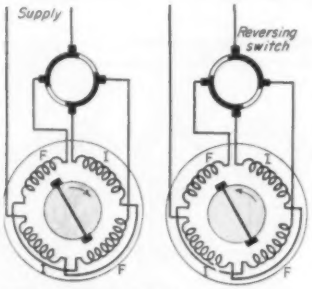
SHORT-CIRCUITED brushes rest on dc-type commutator. Unit suited for plugging

9 BUT THESE UNITS ARE REVERSED BY AN EXTERNAL SWITCH

In this section we meet still another repulsion motor, top sketch, that has a special stator winding using the "swing" type connection. This motor can be reversed without altering the brush position. The stator is fitted with a winding *I*, which we'll call an "inducing" winding. In addition, it has two main windings, F_1 and F_2. Windings *I* and F_1, or *I* and F_2, are energized depending on direction of rotation desired.

Lower sketch illustrates still another repulsion motor that can be reversed by switching without change in brush position. This likewise has an inducing winding *I*, on the stator in series with field winding *F*. Reversal of rotation is handled by reversing direction of current flow in either the winding *I* or *F*. Do not reverse current in both windings at same time.

Still another type repulsion unit is fitted with two sets of brushes. They may be on the same or different commutators. For one direction of rotation one set of brushes are short circuited, and the other set left open. For the opposite rotation, the other set of brushes is short circuited and the first set left open. Ultimate result is the same as physical movement of brushes on commutator.



REVERSING SWITCH changes polarity of but one winding; here, coils marked *F*

Much effort and money has been spent to make flyash useful. Do you know what has been done to date? Here's a roundup of published information on . . .

By WALTER H COBBS, JR
Southern Research Institute

. . . Using Powdered-Coal Flyash

► THIS DISCUSSION AND LIST refers to flyash formed from burning pulverized coal and carried by flue gas to the stack. It is not intended to include other materials of larger particle size and greater carbon content, such as fine cinders. We believe the list includes nearly all the articles and patents of interest that have been taken from major abstract journals up to May 1, 1950.

Construction Uses. Using flyash in the large field of Federal construction during 1949 stimulated interest in its further application. Delivery of a total of 140,000 tons of flyash was started at Hungry Horse Dam in Montana. It replaces a large part of portland cement for the concrete in the dam. Since Hungry Horse will be the fourth largest dam in the world, using flyash there helps to promote the material. Recently the Bureau of Reclamation has decided to use flyash in the Canyon Ferry Dam and power plant.

Flyash Costs. Legal requirements (54—number refers to bibliography on pp 88, 89) are becoming stringent on the removal of flyash from flue gas before discharging to atmosphere. Usually ash must be separated and disposed of satisfactorily. This operation is costly.

Walker (61) gives results of surveying economics of flyash disposal. He reports that 22 industrial and 52 public utilities collected and disposed of 1,543,195 tons of flyash in 1948 at a cost of $1,025,306. This is an average cost to industrials of 85c per ton, to utilities of 66c per ton with an over-all average of 67c per ton. In addition to disposal costs, the utilities have an investment of about $30,000,000 in equipment for arresting flyash.

Total cost of ash delivered to Hungry Horse Dam is reported as $11.50 per ton, of which $10 is for transportation from Chicago. Even so, the Bureau of Reclamation expects to save more than one million dollars on portland cement replacement alone. One large-scale market seems to be opening up for this material. This market offers promise of allowing disposal costs to be minimized greatly, if not totally eliminated.

Note: Bibliography based largely on "Report on the Literature Survey on Fly Ash," prepared March 1949 by W L Belvin and A R Black, Southern Research Institute, for the Nashville Coal Co, Inc.

Concrete Characteristics. Handy (35) describes use of flyash in concrete by the Chicago District Electric Generating Corp, Chicago Sanitary District, Wisconsin Highway Commission, Kansas State Highway Commission and the National Concrete Masonry Association.

Most extensive and basic work on flyash in concrete was done by Davis and his associates (20-25). Results of their studies and experiences are summarized in his description (35) of the effect of flyash on concrete properties. Blanks (10) gives similar information in a recent paper. Briefly, water requirement remains unchanged, workability improves markedly, heat of hydration and temperature rise are smaller.

Compressive strength above 70 F and after 14 days equals or betters that of concrete using no flyash. At lower temperatures more time is needed for flyash concrete to reach comparable strength. Late strength exceeds portland cement concrete. For ash carbon content of less than 10% the dry shrinkage of flyash concrete is less than that

made with a portland cement material.

With over 2½% air entrainment and 20% flyash cement, resistance to freezing and thawing is about 1.75 times that for standard concrete. Last, but perhaps most hopeful, flyash in concrete appears to reduce greatly the expansion and deterioration of concrete from alkali-aggregate reaction. Further research work is now in progress on this phase of the picture. Other work on flyash used in concrete is given in references 7, 14, 26, 30, 34, 37, 39, 40, 42-47, 55, 58-60 and 63.

Other Flyash Uses. Extensive surveys of potentially profitable flyash uses include those of Weinheimer (63), Minnick (46), Thompson (59) and Thorson and Nelles (60). Flyash used in concrete was found highly successful in all surveys. Next in importance seems to be in bitumastic (asphalt) road construction as a fine filler. The Detroit Edison Co disposed of 1,200 tons of flyash for this use in 1948 (64). Randall (52) and Minnick (46) describe a promising new development in a high-quality, red vitrified brick. It is similar in appearance to the common shale brick but more uniform, stronger and less permeable than the usual product by the inclusion of flyash. Standard brick-making equipment may be used for manufacture. Research is under the sponsorship of Philadelphia Elecrtic Co at G and W H Corson Laboratories.

A superior insulating cement has also been developed (52, 70). Randall (52) states that flyash shows promise as a soil-stabilizing agent in road construction. The third-ranking successful use of flyash is in building materials other than concrete, see references 35a, 37, 43, 46, 48, 50, 62 and 68. Cottrell block employs 90% flyash and is a successful building block. Other building blocks may be made from flyash combined with slag.

Other applications include use as: an impregnating agent for wood (9), a fine blasting sand (16), foundry sand (52), bleaching clay after acid leach (55), raw material to make portland cement (58), heat-resistant paint filler (66), in compounding of recording discs (69), in asbestos cement (70).

Problems. Significantly, Weinheimer (64) has pointed out that acceptance of flyash as a material on a technical basis is only part of the problem. The potential customer may be antagonistic for various reasons. A well-integrated engineering sales program may be a necessity to gain acceptance.

Handling problems are uppermost among the difficulties to be overcome by the customer. For work on these see references 1, 6, 19, 28, 29, 32, 38, 56 and 57, and especially Thompson (59).

HERE'S THE RECORD OF WHAT'S BEEN DONE . . .

1 Anonymous, "What Becomes of the Flyash?" *Power, 89,* 619 (1945). Flyash may be collected, then dumped either while dry or after wetting to facilitate handling.

2 Anonymous, "Ash Disposal Done on a Continuous Basis," *Electrical World, 120,* 2260 (1943). Waste cooling water washes flyash to the sluice.

3 Anonymous, "Fuel Beds and Flyash," *Power, 82,* 768 (1938). Discussion of Thorson and Nelles article (60).

4 Anonymous, "How Reduce Flyash?" *Power, 85,* 127, (1941). Discusses construction of flyash removers.

5 Anonymous, "Smoke, Flyash and Cinder," *Power, 84,* 800 (1940). Causes of smoke, flyash, cinders in air and methods of removal.

6 Anonymous, "Use of Flyash as Concrete Additive," *Rock Prod, 51,* 147, Oct (1948). Describes batching plant for preparing and loading transit flyash concrete mix every 30 sec.

7 Avery, W M, *Pit and Quarry, 39,* 157 (1947). Advantages of replacing from 25 to 30% portland cement by flyash; workability, strength, surface texture and waterproofing quality improved.

8 Barkely, J F, *Combustion, 9,* 32-3 (1937). Results of analyses and screen tests on flyash reported in connection with plant operating data.

9 Barmock, B J, *Elec World, 122,* 877 (1944). An antidecay agent for impregnating wood, using flyash, fuel oil and pentachlorophenol.

10 Blanks, R F, *J Amer Concrete Inst, 21,* 701, (1950). Effects of flyash in concrete on workability, compressive strength, durability, permeability, heat of hydration, volume change and alkali-aggregate reaction.

11 Bloomenthal, S, and Deutch, I, *Trans Illinois State Acad Sc, 33,* (2) 178 (1940). Study shows suspensions of smoke and ash in water have pH values fairly characteristic of fuels and furnaces involved.

12 Bowman, K H, *Proc Smoke Prevention Assn Am, 37,* 57-65 (1943). Describes arrester for removing flyash from stream after spreader stoker. Ash disposed by reinjection in furnace.

13 Braig, *Warme, 63,* 243 (1943), *Chem Abs. 36,* 4996 (1942). Describes flyash separator using wetting method.

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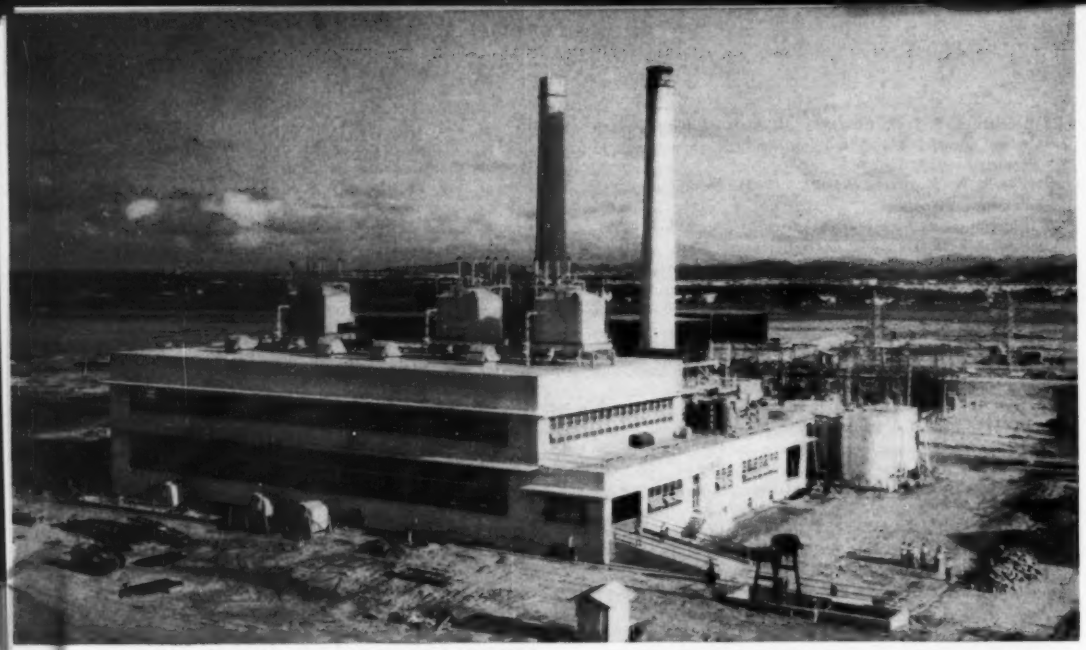


SEMI-OUTDOOR LAYOUT of Puerto Nuevo Station places boilers, fans, deaerators, station-service transformers outside of building, at rear. Traveling water screens stand adjacent to the near wall of the building at end of the 250-ft underground tunnels

Shellfish love circulating-water channels because moving water brings them food. Pests clog tunnels so we planned . . .

. . . PUERTO NUEVO to Fight Fouling

By L J MYSKOWSKI
Jackson & Moreland, Consulting Engineers
and M A QUINONES
Puerto Rico Water Resources Authority

► PUERTO NUEVO Steam-Electric Station, on the south shore of San Juan Harbor, Puerto Rico, started its Unit No. 1 on Sept 22, 1950, and No. 2 on Nov 24, 1950. No. 3 went on the line in March of this year. No. 4 will be delivered in 1952. The first three units consist of 20,000-kw preferred standard turbine-generators supplied by 200,000-lb-per-hr boilers.

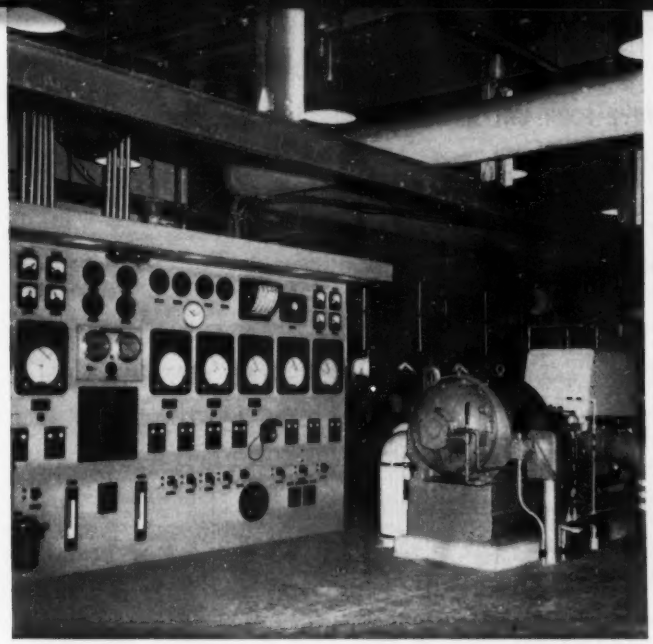
The first two units take care of load growth and replacement of the floating power plant, *Seapower*. Building No. 3 unit about one year ahead of need, as forecast in 1948, reduces cost of operation, construction and engineering design. The floating power plant largely determined steam conditions of this new land plant. Skilled personnel were imported to operate the *Seapower* and train local personnel for a 2-year period. The turbine throttle conditions are 900 psig and 900 F. Although high fuel costs and unit size might justify higher steam conditions, it was decided to make them the same as those of the *Seapower*, to take advantage of operating personnel's familiarity with that equipment.

All equipment has been designed for continuous operation at rated load with 900-F steam. Contrary to usual practice in the U. S. and as an operating precaution, the 900-F superheater outlet temperature can be reached only at full rated output of 200,000 lb per hr. Since the steam plant will probably be base-loaded, economy should be nearer that of a 900-F plant instead of the preferred-standard temperature of 850 F.

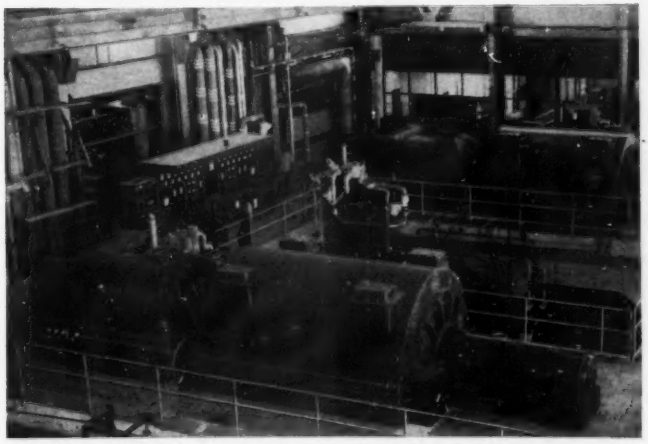
Station Layout. The semi-outdoor design places boilers, fans and other auxiliaries in the open with boiler front and burners under cover. A steel and concrete structure houses the turbines and operating bay. Service transformers, deaerators, cooling towers, continuous-blowdown equipment, fuel-oil pumps, heaters and evaporators are all outdoors. These were designed to withstand hurricanes of 150 mph (50-psf wind pressure). Station layout was governed largely by: (1) limited availability of operating personnel trained in high-pressure high-temperature operation and maintenance (2) mitigation of fouling in the circulating-water system throughout the year.

Operation. In view of high fuel costs, operators must take full advantage of plant efficiency. Centralized controls help this objective and keep down the number of operators needed.

Only part of a steam plant is affected by choice of steam pressure. This includes boiler, turbine, boiler feed pump and their respective controls. Auxiliaries, such as fans, fuel-oil heaters, deaerators, low-pressure heaters, condensers and others, do not call for a change in caliber



OPERATING BAY, as seen from turbine room, has common control board for No. 1 and 2 boilers standing next to boiler feed pumps and boiler burner front, right rear



UNITS NO. 1 AND 2, 20,000-kw preferred-standard machines, have common control board next to operating bay, seen through the columns at left rear; offices at back

of personnel because of steam pressure increase.

Operating bay of the station is really a large control room. Here are controls for: boiler, turbine, motor-operated valves (mimic diagram), hydrogen system, boiler feed pumps, air-operated soot-blower system, main switchboard for all generators and outgoing lines. In addition there are burner wind boxes, boiler fronts, boiler feed pumps and station service switchgear. High-pressure end of the turbine stands adjacent to the operating bay with no intervening wall.

Most piping stays out of normal operating area by running under the operating bay. Piping and conduit passing through the bay are grouped at about the column line dividing turbine room and the bay.

Controls for pairs of boilers and pairs of generators will be consolidated on respective boards as the station grows. Operating level stands less than five feet above ground level. On ground level outside the operating bay are the fans, air heaters, fuel-oil pumps and chemical-treatment system.

Circulating-Water Fouling. On Puerto Rico, particularly around San Juan Bay, circulating-water system fouling persists. It becomes worse during certain parts of the year. Precautions were taken to minimize capacity outage from condenser fouling and impairment of station economy. These include:

1. Duplicate intake tunnels from bulkhead line to station. Each tunnel can carry water needs for ultimate station.
2. Duplicate tunnels within station proper.
3. Interconnection of circulating-water piping in station, providing complete loop for each of two units.
4. System designed for reverse pump operation.
5. Design provisions for additional future antifouling measures.

Since the station stands 250 ft from the bulkhead line and the intake tunnels are covered, cleaning them presents a serious problem. With a single tunnel, cleaning would mean shutting down the station. Hence, either of the duplicate tunnels alone can carry the complete station.

Trash screens for the tunnels stand at the wharf, but the traveling water screens stand adjacent to the plant building, at the end of the 250-ft-long tunnels. Intake chamber in the wharf was excavated to depth minus 30. This taps water that runs about 3 to 4 degrees cooler than surface water.

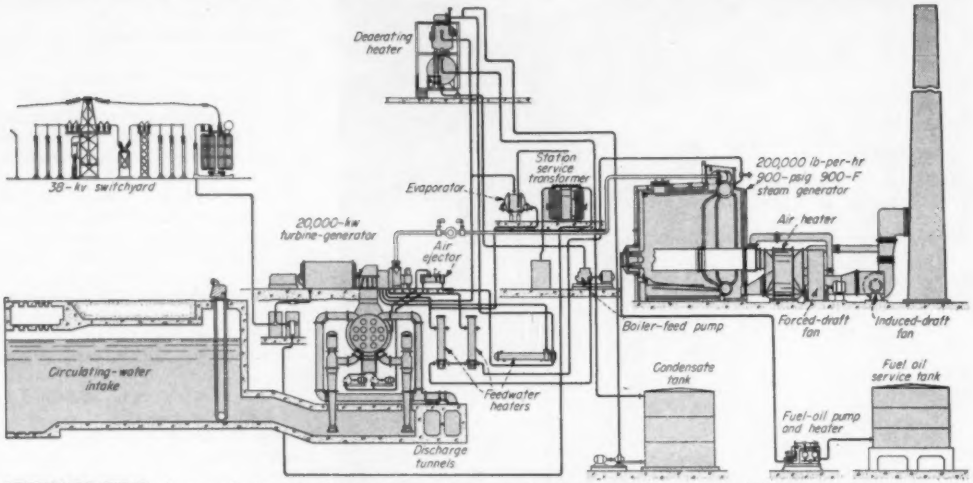
Stop logs at the intake chamber across the 10-ft-wide tunnels will unwater them as needed. An apron wall within the intake chamber has an opening at the bottom 8 ft high and 10 ft wide through which the cooling water enters the tunnels. This wall will serve as the support for a motor-operated gate that will be installed in the future if frequent unwatering proves necessary.

Just outside the building the tunnels branch into duplicate tunnels serving each pair of units. Each pair can be supplied through just one tunnel. Of course, one tunnel can be cleaned while the other is in service.

Tunnel Operation. We considered coating the intake tunnels with flaked copper impregnated in bituminous enamel. But this compound will not withstand 100 to 110 F temperatures, which will be reached during reverse flow. We deferred application of this antifouling compound pending further investigation.

Under the turbine room both intake and discharge tunnels are in duplicate. Outside the building the discharge tunnel becomes an open channel for about 400 ft. The remaining distance of 250 ft under the water-front area is covered. Mouth of the discharge tunnel in the wharf

PUERTO NUEVO WILL SOON HAVE FOUR UNITS, EACH TURBINE SUPPLIED BY ONE BOILER

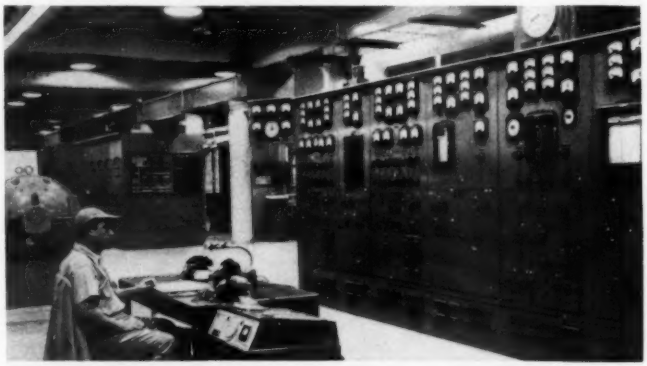


SCHEMATIC SETUP of one unit. Regenerative cycle uses three closed heaters and deaerator. Steam-jet air ejector stands on turbine operating level. 200,000-lb-per-hr steam generator has economizer, vertical regenerative air heater, fans outdoors

stands about 435 ft from the intake chamber. No shellfish difficulties arise in any of the steam-plant discharge tunnels, hence they are not provided in duplicate for Puerto Nuevo.

The 20,000-sq-ft condensers have aluminum-brass tubes. The units have two passes with divided waterboxes. Two pumps serve each condenser. Each of the vertical propeller-type pumps runs at two speeds. A loop interconnects all four pumps of each pair of condensers.

Normally, four pumps at low speed will pass 20,000 gpm water through each condenser. With one tunnel out of service, the two pumps being fed from that tunnel will be shut down. The other two pumps running at high speed will then supply both condensers from the remaining tunnel in service. Little, if any, reduction in efficiency will be caused by this operation.



GENERATOR CONTROL PANEL for Units No. 1 and 2 stands in operating bay facing corresponding boiler control panel. Motor drive for boiler feed pump at far left

Shellfish Experience. In Puerto Rican waters shellfish thrive in water temperatures as high as 85 F. No shellfish growth of consequence has been observed in the warmer discharge of steam-plant cooling systems. Apparently a base temperature does not govern shellfish life, but a rise in temperature above normal does inhibit growth. In the U. S. where water temperatures run about 60 to 70 F, very little shellfish growth has been found in discharge tunnels with temperatures of 80 to 85 F. The Puerto Rican variety though, thrive at the higher temperature which must be raised more to discourage growth.

The *Seapower* was used for a series of antifouling experiments. Shortly after it went into service shellfish accumulated in the intake lines at 79 to 83 F. They grew until they could no longer retain their hold on the walls. When dislodged they entered the condensers but could not pass through the tubes. This accumulation was eliminated by evolving the present practice of sealing off each half of the circulating-water system in turn and heating the trapped water to about 110 to 115 F. This temperature is held for about four hours. The heating process is carried out once every seven days. This has maintained plant efficiency between a range of 10.99 to 11.52 kwhr per gal over a 4-year period.

Heating steam needed for the *Seapower* is small. Long tunnels of the land plant, however, would need considerable heating steam. Instead of doing this, the heating will be done by reversing circulating-water flow. The propeller pumps can run in reverse rotation. Pump propellers are at grade–19, center line of condenser at grade+2, and discharge piping at grade +7. Some exhauster action will probably be needed to establish the siphon flow in

PRINCIPAL POWER-PLANT EQUIPMENT

Units No. 1, 2 and 3, Puerto Nuevo Steam Plant, San Juan, Puerto Rico, Puerto Rico Water Resources Authority

STEAM-GENERATING EQUIPMENT:

Boilers, 3 ..... Combustion Engineering-Superheater, Inc
200,000 lb per hr, 900-psi 900-F steam, oil fired, outdoor
Superheaters, 3 ..... Combustion Engineering-Superheater, Inc
Loop elements, 900-F at full load, bypass-damper temperature control
Air heaters, 3 ..... The Air Preheater Corp
Regenerative, horizontal shaft, motor driven
Forced-draft fans, 3 ..... Sturtevant Div, Westinghouse Electric Corp
69,000 cfm of 115-F air against static press. of 10 in. water, multivane, double width, double inlet, inlet vane control
Forced-draft fan drives, 3 ..... Westinghouse Electric Corp
Induction motor, 150 hp, 1200 rpm, 3 phase, 60 cycle, 440 v
Induced-draft fans, 3 ..... Sturtevant Div, Westinghouse Electric Corp
115,000 cfm of 300-F gas against static press. of 8 in. water, double width, double inlet, inlet vane control
Induced-draft fan drives, 3 ..... Westinghouse Electric Corp
Induction motor, 250 hp, 900 rpm, 3 phase, 60 cycle, 440 v
Chimneys, 2 ..... Rust Engineering Co
Tapered reinforced concrete, brick lined, 150 ft, 9-ft 6-in. internal top diameter

POWER-GENERATING EQUIPMENT:

Turbine generators, 3 ..... General Electric Co
20,000 kw preferred standard, 3600 rpm, 850 psig, 900 F, 23,529 kva, 0.86 pf, 0.8 short-circuit ratio, 3 phase, 60 cycle, 13.8 kv, hydrogen cooled
Main exciters, 3 ..... General Electric Co
95 kw, 250-v, direct connected, enclosed, self ventilated
Pilot exciters, 3 ..... General Electric Co
4 kw, 125 v, direct connected, enclosed, self ventilated
Condensers, 2 ..... Westinghouse Electric Corp
20,000 sq ft, radial flow, two pass, divided waterboxes, 4365 ¾-in. No. 18 BWG aluminum brass tubes
Condenser, 1 ..... Condenser Service & Engineering Co
20,000 sq ft, two pass, divided waterbox, 4370 ¾-in. 20-ft 2½-in. No. 18 BWG aluminum brass tubes
Circulating-water pumps, 4 ..... Westinghouse Electric Corp
Vertical, 2-speed reversible, low-speed: 10,000 gpm at 20-ft TDH; high-speed: 20,000 gpm at 25-ft TDH
Circulating-pump drives, 4 ..... Westinghouse Electric Corp
125/70 hp, 1170/880 rpm, 440-v motors
Circulating-water pumps, 2 ..... Peerless Pump Div, Food Machinery & Chemical Corp
Two-speed reversible, low-speed: 9200 gpm at 20-ft TDH; high-speed: 18,400 gpm at 25-ft TDH
Circulating pump drives, 2 ..... Westinghouse Electric Corp
Vertical motors, 56/150 hp, 18/12 pole, 390/580 rpm, 440 v
Condensate pumps, 4 ..... Westinghouse Electric Corp
Horizontal, 2-stage, 360 gpm, 225-ft total head, 1170 rpm
Condensate-pump drives, 4 ..... Westinghouse Electric Corp
Induction motor, 40 hp, 1170 rpm, 440 v
Condensate pumps, 2 ..... DeLaval Steam Turbine Co
360 gpm, 1750 rpm, 225-ft total head
Condensate-pump drives, 2 ..... General Electric Co
440-v 40-hp induction motors
Air ejectors, 2, twin, 2-stage ..... Westinghouse Electric Corp
Air ejectors, 1 ..... Condenser Service & Engineering Co
Twin, two stage
Priming ejectors, 2 ..... Westinghouse Electric Corp
Single-stage, steam-jet
Priming ejector, 1 ..... Condenser Service & Engineering Co
Single-stage, steam-jet

INSTRUMENTS:

Boiler combustion control ..... Bailey Meter Co
Feedwater regulators, three element ..... Bailey Meter Co
Flowmeters ..... Bailey Meter Co
Conductivity recorder ..... Leeds & Northrup Co

FEEDWATER EQUIPMENT:

Boiler feed pumps, 5 ..... Worthington Pump & Machinery Corp
240,000 lb per hr, 1100 psi TDH (one pump suitable for future dual drive)
Boiler-feed-pump drives, 5 ..... General Electric Co
500-hp, 3580-rpm, 3-phase, 600-cycle, 440-v motors
Deaerating heaters, 3 ..... Cochrane Corp
250,000 lb per hr, horizontal, direct-contact tray type
Feedwater heaters, 6 ..... Condenser Service & Engineering Co
High pressure, 834 sq ft, vertical, closed
Feedwater heaters, 3 ..... Ross Heater & Manufacturing Co
Low pressure, 848 sq ft, horizontal, straight tube
Evaporators, 3 ..... Davis Engineering Co
10,000 lb per hr fresh water, horizontal, straight tube
Evaporators, 1 ..... Davis Engineering Co
5000 lb per hr salt water, horizontal, straight tube, for emergency service

PIPING:

Pipe fabrication ..... Bethlehem Steel Export Co; Midwest Piping & Supply Co
Nonreturn and h-p valves ..... Crane Co
Pipe covering ..... Philip Carey Manufacturing Co

ELECTRICAL EQUIPMENT:

Station service transformer, 3 ..... Standard Transformer Co
1500 kva, askarel filled, 38-kv primary, 460-v secondary
Emergency transformer, 2 ..... Standard Transformer Co
2000 kva, 3 phase, askarel insulated, 14,400-480 v
440-v switchgear, 1 ..... I-T-E Circuit Breaker Co
Indoor, horizontal drawout, rated 600 v for 480 v, 3 phase, 3 wire, 60 cycle
Power transformer, 3 ..... General Electric Co
25,000 kva, 60 cycle, 38-kv wye, 13.8 kv delta, 3 phase, oil-immersed outdoor type
Main oil circuit breakers, 11 ..... General Electric Co
Outdoor, 46 kv, 1200 amp, 1,000,000 kva

MISCELLANEOUS:

Steel tanks ..... Pittsburgh Des Moines Steel Co
2 city-water storage, 50,000 gal
2 condensate storage, 50,000 gal
2 fuel-oil storage, 50,000 gal
4 fuel-oil storage, 50,000 bbl
Soot-blower air compressor, 2 ..... Worthington Pump & Machinery Corp
Tandem, two stage
Compressor drives, 2 ..... Westinghouse Electric Corp
100 hp, 1180-rpm induction motors
Turbine-room crane, 1 ..... Harnischfeger Corp
60-ton 4-motor overhead, 15-ton auxiliary hoist, 70-ft span
Traveling intake screens, 3 ..... Link-Belt Co
Vertical, 29-ft centers
Traveling-screen drive ..... General Electric Co
1-hp 1730-rpm induction motor

CONSULTING ENGINEERS ..... Jackson & Moreland

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reverse. Provisions have been made to apply this to the top of the condenser discharge waterbox. Reversal will be done in one half the condenser at a time, with the turbine carrying light load. Pump capacity in reverse drops to about 50% normal.

Under full-load conditions with 20,000 gpm, water temperature rises about 15 F. This is expected to be enough to keep the discharge tunnel free of shellfish. To obtain a greater rise, if needed, butterfly valves in the water lines to the condenser restrict the flow. These will also be used with reverse flow to raise the temperature and reduce the length of reverse operating time.

On the basis of the *Seapower* experience we expect reverse operation to be needed once a week for a period not over 8 hr with 110 F. Provisions have been made to install later one pump per unit for reverse flow, should the present pumps prove too uneconomical for this purpose.

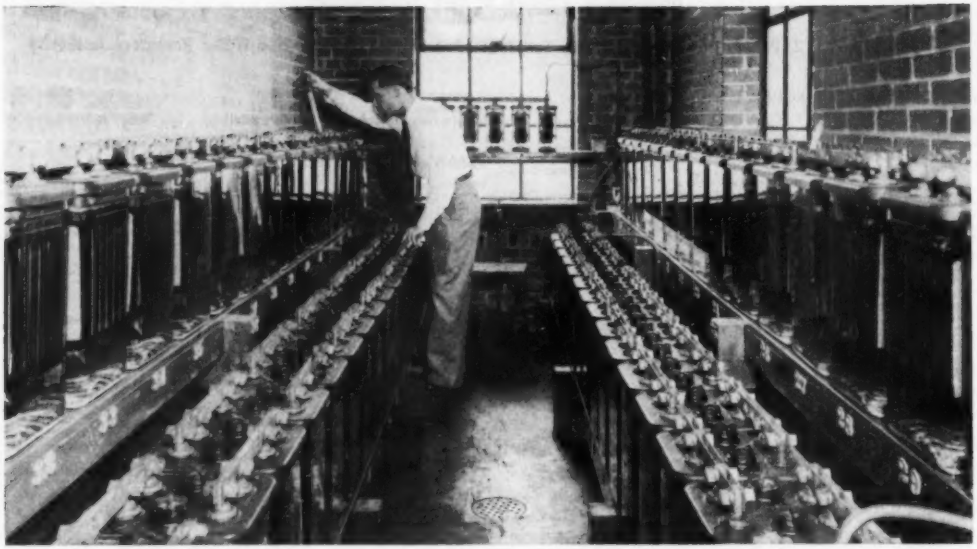
One of the most effective, though obnoxious, methods of shellfish control has been built into the duplicate tunnel arrangement. This consists of periodic exposure of the shellfish in the tunnels to air. Should hot water prove ineffective, air exposure can be used though it is least preferred.

Effectiveness of these controls cannot be determined until several months of operation have elapsed.

Planners. Jackson & Moreland were consulting engineers on the design of Puerto Nuevo. Raymond Concrete Pile Co constructed the bulkhead, wharf, foundations and powerhouse.

Installation of the station machinery and equipment, as well as construction of the machine shop and warehouse buildings and other site improvements was done by Puerto Rico Water Resources Authority.

The Authority was organized in 1941 to develop the hydro generating capabilities of the Island. The system includes 17 hydro and 5 steam plants.



CHECKING SPECIFIC GRAVITY OF A 60-CELL 240-AMP-HR CONTROL BATTERY IN 30,000-KVA SUBSTATION

Getting full life from storage batteries is a matter of sound selection, top-notch maintenance. Pennsylvania Power and Light Co has carefully followed this practice with outstanding results. Here's the step-by-step procedure they have adopted

By J E VAUGHAN
Manager, Sales Engineering
Gould-National Batteries Inc

Storage-Battery Life Can Be

► BATTERY SELECTION breaks down to a 2-step operation: first the voltage requirements, and second the ampere-hour capacity needs. Over-all battery voltage is determined by voltage rating of existing and future control equipment. To determine total cells, each cell is rated at 1.75 v at 77 F. This is the terminal voltage of the cell at end of contemplated service-time. Thus the required number of cells equals equipment voltage divided by 1.75.

Battery Capacity. Total capacity needs are divided into three load classifications: (1) *Short-time* operation for switchgear. Number of breakers operated simultaneously and current needed for each operation are considered for closing and tripping. (2) *Continuous load* taken by indicating lamps, relay holding coils, etc. Duration of this type load may vary from 8 to 24 hr depending on type station. (3) *Emergency-lighting* load is determined by number and wattage of required emergency lights and length of time this service may be needed.

Once the time element is known for each type load, manufacturers' curves are used to determine required capacity of a single positive plate. These curves give amperes per positive plate versus time during which battery will be discharged to 1.75 v per cell. Hence the number of positive plates for each load is found by dividing ampere needs of the load by capacity per positive plate. Then the number of positive plates needed for the above three load classifications are totaled. This gives the total required plates and hence the battery.

Installation, Maintenance. Cells are now mounted on metal racks that are painted with an acid-resisting coating. Each cell location is numbered to simplify record keeping. Battery rooms are well lighted and properly ventilated.

Maintenance plan in a nutshell consists of (1) monthly check on each cell and (2) good system of record keeping.

Voltage and specific gravity readings of each cell are taken on every inspection. These readings are plotted as shown on facing page. This individual cell-plotting simplifies spotting any cell that varies abnormally from the correct voltages and specific gravity.

Spot checks on cell temperature are also made. And amount of water added is recorded. Then three copies of the record are made; original goes to central office, and carbons to division office and maintenance man or operator.

Equalizing Charge. An equalizing charge is given once every three months. Aim here is to bring all cells up to full voltage. It is done by charging the battery at the "finishing rate." Remember, fully discharged batteries are recharged at a high starting rate. And then when about 80% charged the charge is con-

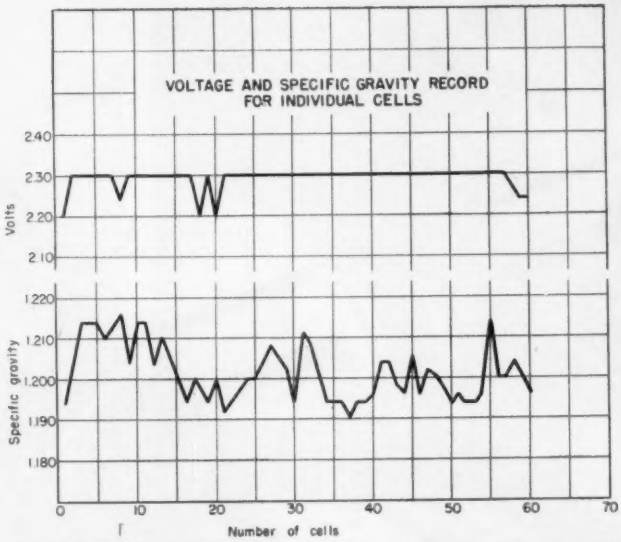
CHARGING BATTERIES . . .

. . . calls for dependable supply of direct or unidirectional current. When power source is ac, change to dc is usually handled by an m-g set or some type rectifier. But even with available dc source, some form of control equipment is needed.

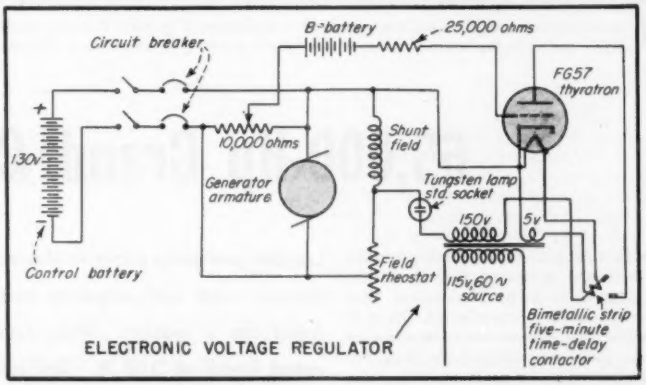
M-g sets generally supply "floating" and equalizing charge to storage batteries. Various type rectifiers also have the-same purpose. Induction-motor-driven shunt-wound generators have been used and are still giving good service where the steady load of signal lamps, relay coils, etc, is constant.

A definite drooping voltage characteristic of m-g set or rectifier is provided beyond full-load point. Aim is to protect generator or rectifier against overload when heavy load currents are drawn for closing circuit breakers.

Rectifiers providing automatically controlled intermittent charging are also used to maintain control batteries. With this equipment, battery is placed on charge at regular intervals by an electric timer. Charge is then terminated by a sensitive voltage relay whose operating point is compensated for temperature variations.



VOLTAGE AND SPECIFIC GRAVITY are carefully recorded for each battery cell. Then additional information on charge voltage, water added, pilot cell, etc, also noted



ELECTRONIC VOLTAGE REGULATOR insures a constant-voltage supply to the 60-cell battery. This is really important where there are swings in dc voltage of m-g set

Stretched

tinued at a low finishing rate. The manufacturer supplies recommended finish rates for any given battery.

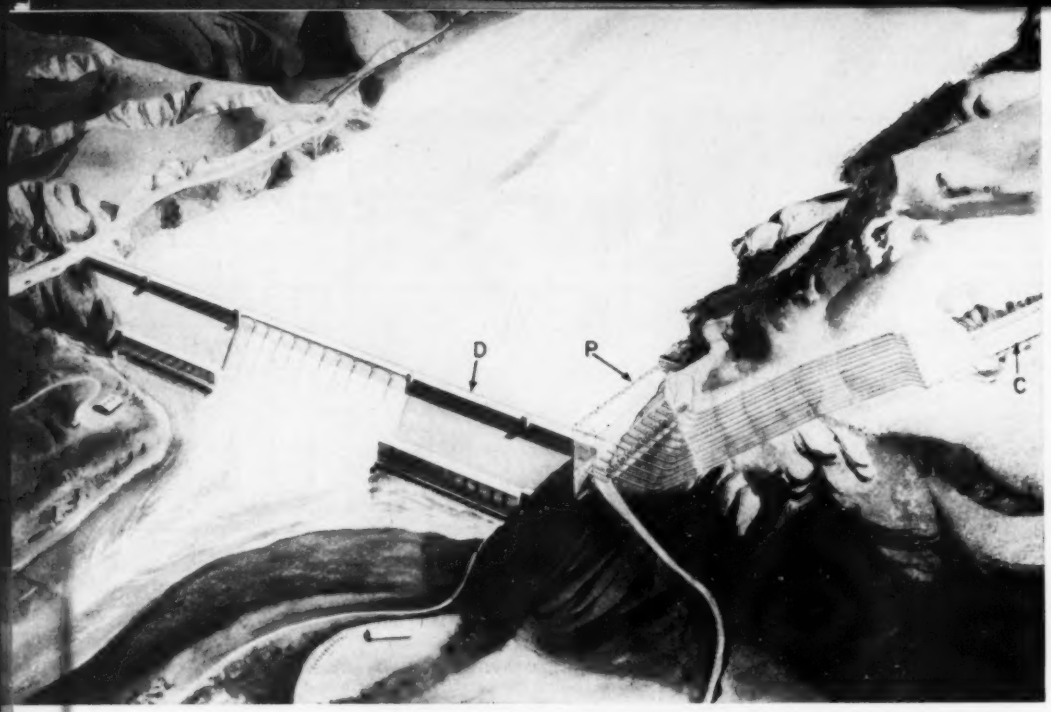
In giving an equalizing charge, pilot cell readings of voltage, specific gravity and temperature are taken. All cells should be fully charged after four successive equal readings. In unattended substations an equalizing charge is given by raising the voltage to 140 for 60-cell batteries. They are left this way for 24 or 48 hr as necessary without supervision.

Just before ending the equalizing charge, voltage of each cell is read and recorded. Then after ending the charge, specific gravity readings of each cell are taken and recorded. If any cell is not fully charged it is replaced. Each cell is wiped clean, and electrolyte level checked when battery is put on equalizing charge as well as at each inspection. Any water added is recorded.

In addition to the record chart above, supplementary information as to cell and ambient temperature, average floating bus voltage during month, cell used as pilot, etc, are recorded beneath the graph. On top of this a master file is kept for each battery. The following information is recorded in this file: location, date installed, ampere-hr capacity (8-hr rate), voltage rating, number of cells, type of service, battery manufacturer, type of positive and negative plates, record of repairs and replacements, and general remarks.

Battery Life. It is difficult to predict with any reasonable certainty a battery's life. One battery at PP&L has been in service for 34 years. It has been intelligently maintained. This older battery has open-type cells. It has glass plates resting on top of each cell to keep extraneous material from falling into the cells. Another reason for these protective glass plates is to condense any gas given off by the cell. Hence the condensate runs back into the cell rather than being given off as vapor.

Each cell in this 34-year-old battery rests in a glass tray filled with sand. This keeps acid, which may creep down the side of the jar, from attacking the wood rack supporting the battery.



1 Grand Coulee dam *D* raises the river level a maximum of 345 ft. To lift the water the rest of the way a pumping plant *P* for a 300-ft head will discharge into canal *C* that leads to a balancing reservoir for purposes of irrigation

65,000-Hp Grand Coulee Pumps

Largest pumping plant in the world will have 12 motor-driven pumps, each with capacity over 1-billion gpd under a 270-ft head for irrigation. They can deliver 940 million gpd at rated head of 310 ft. The impellers are 14 ft in diameter

► EVERYTHING ABOUT GRAND COULEE power and irrigation project, on the Columbia River in Washington, must be expressed in superlatives. Its dam is the most colossal concrete structure ever built, containing more than 12,500,000 cu yd of concrete. It has the largest-capacity (165,000 hp) hydroelectric units in the world. Total capacity (3,012,000 hp) of its power plant exceeds any other so far planned. Now the largest pumping plant goes into service with the most gigantic pumps ever conceived.

The Grand Coulee. The reason for all this goes back a long way in time. Geologists tell us that 25,000 years ago a great ice cap came down from Canada and blocked the Columbia River below the site of Grand Coulee Dam. Behind this ice dam a great lake formed that overflowed the canyon walls 700 ft above normal river level. This forced the river into a new course that cut a great gorge now known as the Grand Coulee.

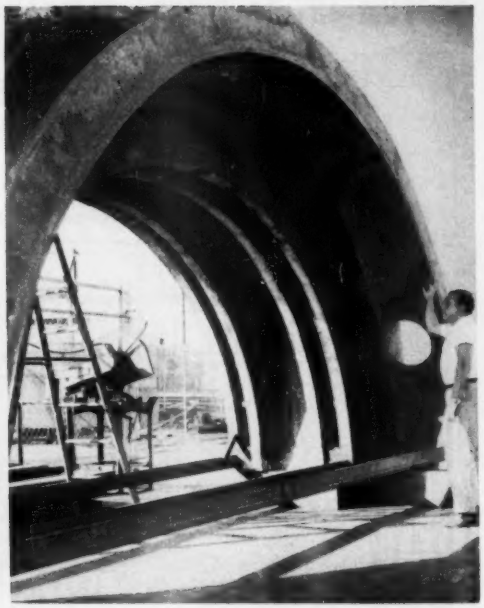
From this gorge about 30 cu miles of silt was spread over a large area of flat country. When the ice dam melted the river returned to its former channel and left a gorge about 50 miles long, 2 to 5 miles wide, and 600 to 1000 ft deep above river level at the site of Grand Coulee Dam. While the silted area is fertile land with a long growing season, it lacks sufficient rain to support agriculture, without irrigation.

Balancing Reservoir. Two dams are being built across Grand Coulee to form a balancing reservoir into which irrigation water will be pumped from the storage reservoir formed by Grand Coulee Dam. From the balancing reservoir, canals will convey water to irrigate over one million acres of arid land.

Fig. 1 shows what is being done to supply irrigation water for this land. Grand Coulee Dam *D* raises the normal river level a maximum of 345 ft. This is about 300 ft below the top of the canyon wall where the water overflowed during the ice age. To raise the water the rest of the way, a pumping plant *P* is being built that will discharge into canal *C* leading to balancing reservoir.

As shown in photo, the pumping plant is just upstream from the west end of Grand Coulee Dam. Reservoir side of the pumping plant, Fig. 4, forms a wing wall set at a 67-deg angle to the main dam. This part of the plant along with its trash racks, head gates and intakes were completed with the main dam.

2 Plate-steel accelerated design of short-radius suction elbow for one of the pumps is 14 ft in maximum diameter



3 One half of a pump casing. It is built with cast-steel center with diffuser vanes welded to plate-steel volute

Put Into Operation

Plant is planned for a total of 12 pumps. Ten of these are required to meet maximum pumping needs when the irrigation project is fully developed. Because irrigation water must be supplied when needed, two standby units are provided. Six units are now being installed to take care of present irrigation needs.

Large-Size Pumps. Pumps are of unprecedented size, requiring nearly five times the power of the next largest pumping unit in operation in this country. This is the 13,450-hp pump installed by the Lower Colorado River Authority at Buchanan Dam on the Colorado River in central Texas. Some of the pumps of the Metropolitan Water District of Southern California have 12,000-hp motors. Six units for the Tracy pumping plant in California will each be driven by a 22,500-hp synchronous motor. This station is on the Central Valley irrigation system under construction, but its pumps will have only about one-third the power of the Grand Coulee units.

There are several pumps serving pumped-storage hydroelectric plants in Europe that require up to 35,000 hp to drive them. These are part of triple units consisting of an alternator, a waterwheel and a pump. The alternator serves as generator and motor.

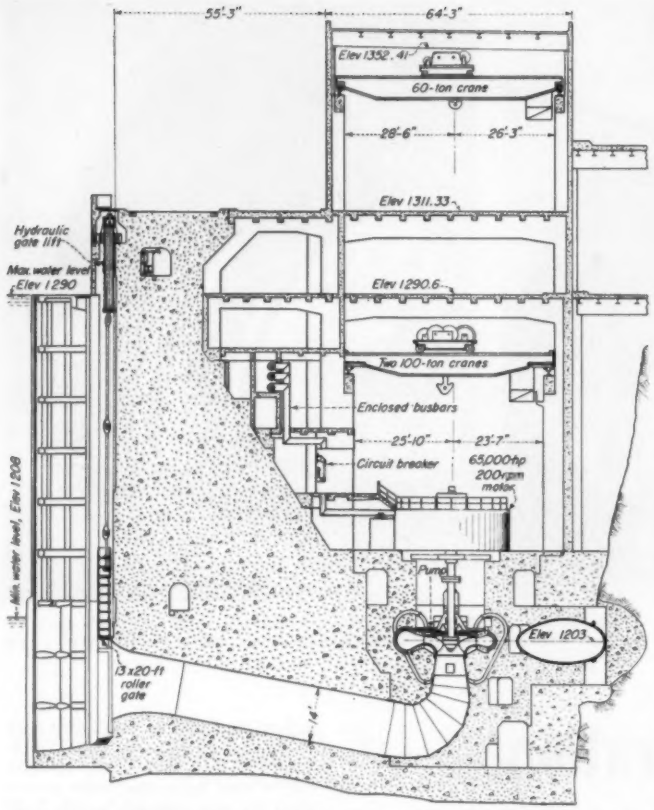
Each Grand Coulee pump will have a 1450-cfs (650,000-gpm) capacity under a head of 310 ft and will be driven at 200 rpm by a 65,000-hp 13,600-v synchronous motor. These motors are similar to hydroelectric generators of equal capacity. They are enclosed in a housing and cooled by a closed system where air is recirculated and cooled by coils through which 900 to 1200 gpm of water flows. Their rotors have squirrel-cage windings to permit starting them as induction motors.

Each pump impeller is 14 ft in diameter and connects to its driving motor by a 27-in. shaft. A motor and pump weigh about 565 tons of which about 225 tons are in the revolving element. Two 100-ton cranes handle pump and motor parts.

Pumping Periods. Because water level changes in Grand Coulee reservoir and in the discharge canal, total head on the pumps will vary from 270 to 365 ft. A large part of the pumping will be done during flood-water periods when the main reservoir is full. Total head then will be about 270 ft, against which each pump will discharge over 1600 cfs (720,000 gpm) or over 1,000,000,000 gpd, nearly equal to amount New York City requires.

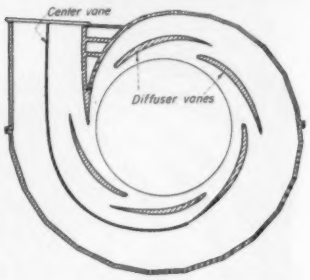
Each pump has its own piping system consisting of (1) trash racks and intake structure with a 13x20-ft roller gate (2) a 14-ft-diameter steel intake pipe through the pumping-plant dam welded to the suction elbow (3) to improve efficiency, discharge for each pump is through a 3-deg tapered pipe extended to match its 12-ft-diameter discharge pipe. Discharge pipes vary in length from 840 ft for the first unit to 640 ft for the last. The most severe suction conditions occur at low capacity when water surface at the intake is at elevation 1208.

Center line of the pumps is placed at elevation 1203 so a positive suction head of at least 5 ft exists on the pumps. This is sufficient to prevent cavitation in them, such as may occur under a suction lift. Since irrigation requires that practically all water be pumped during flood-water periods, possibilities of operating with only 5-ft positive



4 Center line of pumps is placed at elevation 1203 so a positive suction head of at least 5 feet exists on the pumps, which is enough to prevent cavitation

PUMP VOLUTE CASING



5 Cross section through volute casing shows the 5 diffuser vanes and center vane running to discharge flange

suction head are not likely to occur.

Reverse Rotation. Because of the long discharge lines, flow will reverse through the pumps during a normal shutdown. Reverse speed during these periods will be less than maximum runaway. To take care of these conditions the motors are designed for reverse rotation and for stresses due to a runaway speed of 295 rpm. A thrust bearing above each motor supports the rotor's weight and unbalanced hydraulic thrust, totaling over 300,000 lb. These bearings are equipped to positively supply an oil film between their surfaces before starting to keep break-away torque at a minimum. On the four Westinghouse motors and Kingsbury thrust bearings, the oil film is supplied by raising the rotating part ¼ in. with hydraulic jacks, control being provided for this purpose. On the two General Electric motors with spring-loaded thrust bearings, a high-pressure pump forces oil in between the thrust collar and the eight thrust pads.

Starting the Motors. Because of the motors' large size, starting them required careful consideration. Starting on 60 cycles from the power system at reduced voltage would have taken excessively high current and caused high stresses in the winding of generators and motors. This method was dropped in favor of (1) synchronous method and (2) induction-motor method.

Normally the synchronous method will be used. With this method one or two motors will be connected directly to a single generator at standstill. Generator and motor field rheostats will be set to obtain best starting conditions. Both generator and motor field coils are excited simultaneously. When the turbine gates are opened generator and pump motor or motors come to speed by manually regulating the turbine gates. Then the turbine is placed on governor control to maintain 60-cycle speed. This method of starting the motors develops the break-away and accelerating torques required by the pumps.

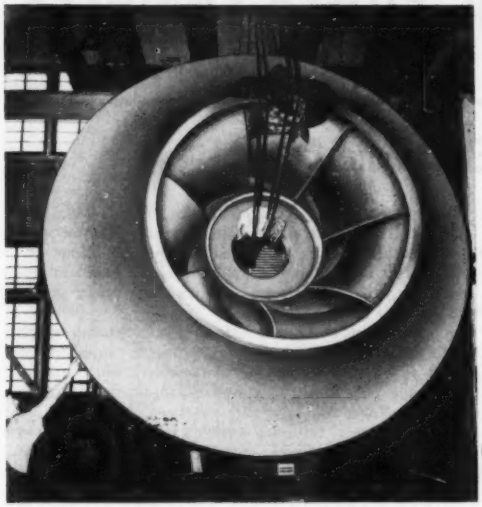
When using the induction-motor starting method, the generator without excitation is started and brought to about 65% synchronous speed for starting one motor and 70% for starting two motors. Generator and the motor or motors are then tied together directly. The generator field coils are excited causing the motor or motors to accelerate. The turbine gates have been closed.

As the motors accelerate and the generator slows down they approach the same speed. When their speeds are close enough to synchronize, the motor field coils are excited and the machines pull into step. The turbine gates are then opened to bring the units up to speed when the turbine is placed under governor control.

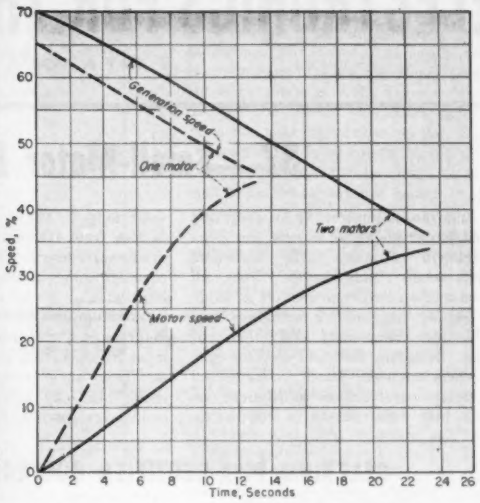
Fig. 7 shows the predicted speed change of the generator and motors during starting by the induction-motor method. The dash curves are for starting one motor and the full ones for two. When starting one motor the generator is accelerated to 65% speed without excitation. Then turbine gates and motor circuit breaker are closed and generator field coils excited. Generator slows down to 45% speed while the motor accelerates as an induction motor to about the same speed in about 13 sec. At this point motor field switch is closed and the motor pulls into step with the generator. Turbine gates are again opened, and generator and motor come up to full speed and the turbine is put on governor control.

When starting two motors the same procedure is followed for one, but the generator is accelerated to 70% speed. It is then connected to the motor and slows down to 35% speed, while the

SEVEN-VANE PUMP IMPELLER AND STARTING CURVES OF THE MOTORS



6 Pump runner, made in one cast-steel piece, is 14 ft in diameter, has 7 vanes, 27-in. shaft, operates at 200 rpm



7 Predicted speed change of generator and motors during starting by the induction-motor method; one or two motors

motor accelerates to the same speed in about 23 sec. Motor field switches are then closed, after which the motors and generator pull into step. The turbine gates are then opened to bring the units up to speed when the turbine is placed on governor control.

Generators No. 1 to 6 in the west powerhouse can be connected through stepup transformers to the main bus or directly to two pump motors. This permits the generators to give dual service, either supply pumping or commercial load. Each generator supplies a 125,000-kw load continuously, so can easily take care of the two pump motors assigned to it.

May to August inclusive are high-water months at Grand Coulee. This period corresponds closely with the irrigation season. As a result, pumping power can be generated from flood water, also available to be pumped for irrigation. Consequently irrigation will be done largely with water that would otherwise run to waste down the river and not be used.

Pump Testing. To obtain basic data on the design of these pumps an extensive testing program was conducted during 1939-1940 at the Hydrodynamic Laboratory of the California Institute of Technology. Several pump manufacturers and the Bureau of Reclamation submitted models for testing. These models included single-, double- and triple-volute pumps, and pumps with diffuser vanes and adjustable guide vanes. Also, several designs of suction elbows and intakes were tested in the laboratory.

From these preliminary tests it was found practical to increase the prototype speed from 150 to 200 rpm, which permitted reducing the physical size of the units with a corresponding saving in cost. A design of short-radius suction elbow that causes flow to accelerate, Fig 2 and 4, was found to perform as well as long-radius or vaned elbow, and was used in the final design.

After awarding the contract for the first six pumps in 1946 to the Byron Jackson Co, a pump builder, and to the Pelton Waterwheel Co, a hydraulic-turbine builder, further tests on models were made. These, combined with mechanical design studies, led to selecting a 5-vane diffuser casing, Fig. 5, with a center vane that runs to the discharge flange. The center vane improves water-flow passages. It is about as thick as the shell and is welded to it. This design is the one that complies safely with hydraulic requirements, and is nearly the simplest and least costly design mechanically.

The casings are being built with a cast-steel center with diffuser vanes welded to the outside plate-steel volute. These vanes serve to form diffusers to reduce the water velocity leaving the impeller and to help transmit part of the foundation load through the casing.

Pumps are guaranteed to have an efficiency of 87%. Stepped up model tests show that they will develop over 90% on field test. Provisions are being made for accurate testing of the pumps after they are installed.

Construction Period. Construction of the pumping-plant foundation started March 21, 1938 and was completed March 20, 1942. Construction under the current contract for completing the pumping plant began Nov 18, 1948. Project is aimed at having construction of canals and other structures far enough advanced to meet the current schedules for large-scale irrigation developments in 1952. This requires that the first two pumping units be in operation by May 1 of this year, which they will be, or shortly thereafter. The six pumps are scheduled for completion by late 1952.

Grand Coulee pumping plant was designed in the Denver office of U.S. Bureau of Reclamation. L N McClellan is chief engineer; structural design supervised by Samuel Judd. Electrical design is under direction of H H Plump, head of electrical division. I A Winter, head of hydraulic-machinery division, supervised design of pumps. H A Parker is acting district manager of Columbia River district, and Alvin Darland is in direct charge of pumping-plant construction. Parker succeeded Frank A Banks, who retired as district manager Sept 29, 1950.

ELECTRONICS FOR THE POWER ENGINEER

By F A ANNETT, *Associate Editor*

37—Small-Motor Electronic Control

► ELECTRONIC EQUIPMENT for operating a dc motor on an ac system has been developed in many forms and sold under many trade names. They all consist of a rectifier to convert ac to dc to supply the motor's armature and field-coils, the control and other circuits. Selenium disk and electron-tube rectifiers are used. These are connected in various combinations in different circuits with some means of controlling their output. These equipments range in size from fractional to several hundred horsepower. We will consider some of these in this article and two later on.

Selenium-Disk Rectifiers. Fig. 1 is the diagram of a General Radio Co equipment for operating small dc shunt motors from an ac system and adjusting their speed, by armature-voltage control. Selenium-disk rectifiers are used in the armature and field-coil circuits. In the armature circuit eight rectifiers are connected in a double-bridge circuit. To supply field excitation four rectifiers are used in a single-bridge grouping.

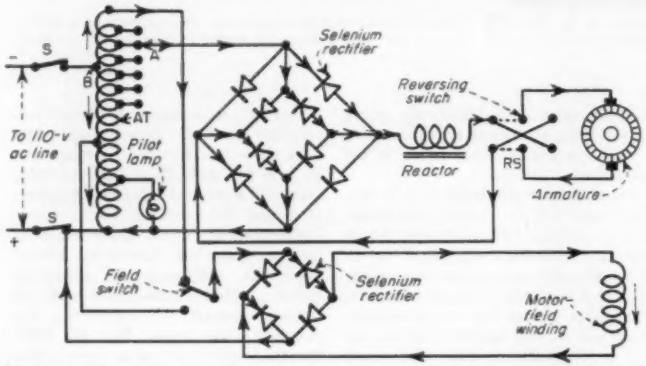
Autotransformer *AT*, through which the motor armature is supplied, is tapped for contacts over which arm *A* can be moved to adjust the armature voltage and its speed. If required, a reversing switch can be built into the control. A single-pole double-throw switch in the field-coil circuit permits exciting these coils on part voltage to obtain speed above rated value. A small pilot-lamp is connected across a section of the transformer to indicate when the equipment is alive. All parts of the control are combined into a compact unit for easy installation.

Field-Coil Circuit. Assume line, reversing and field switches closed and line polarity as shown. Current now flows from — to + through the transformer winding *AT*, and in doing so induces a counter-voltage opposite to that applied, as indicated by the arrow on the top section. The field circuit is from *B*, through one arm of the rectifier, the motor field winding, another arm of the rectifier, and to the + line. When line polarity reverses, current flows through the other two arms of the rectifier but in the same direction through the field coils.

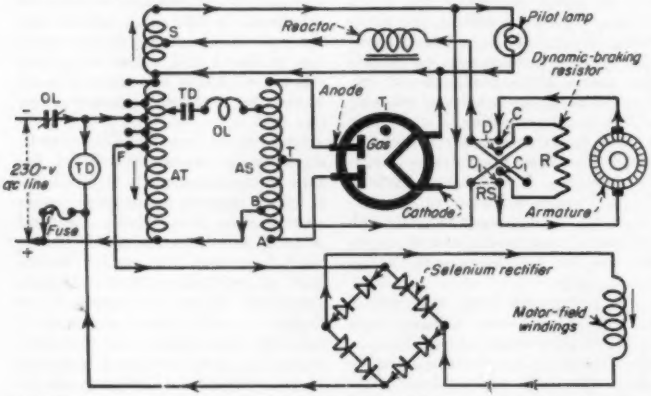
Armature Circuit. This is from tap *A* through two rectifiers in parallel, the reactor, reversing switch, armature, two more rectifiers in parallel and to the + line. On reverse polarity, the other rectifier arms come into service to supply dc to the armature. The reactor serves as a filter to smooth out the current waves from the rectifier, as we have learned in several of the preceding articles. The field coils have high reactance and so can serve as their own filter.

Speed Control. Moving contact *A* up, to cut in more of the transformer winding, increases the voltage applied to the motor's armature and consequently its speed. Moving contact *A* down has the reverse effect. If speed is not high enough when the arm is on the top contact, it can be moved to the bottom

SELENIUM DISK-RECTIFIER CONTROLS

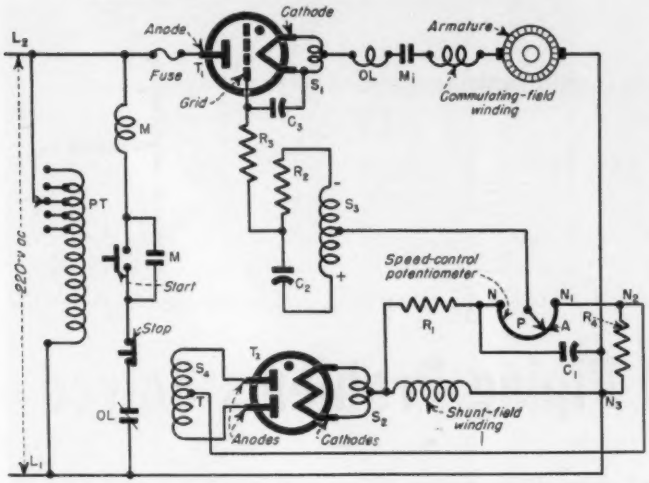


1 Control equipment for operating small dc shunt motors from an ac system and adjusting speed by armature control. Rectifiers in armature and field circuits



2 For this type control a gas-filled full-wave rectifying tube is used in the armature circuit. Armature and shunt field adjustment give a wide speed range

ELECTRON TUBES SUPPLY MOTOR POWER



3 Fractional-horsepower dc-motor control in which armature and field currents are supplied through gas-filled tubes. Speed adjustment is by armature control

one and the field switch closed to its bottom contact, to weaken the field. Contact *A* can then be moved up to increase armature voltage until the desired speed is obtained.

Larger Size Controls. In larger sizes of controls of this company a gas-filled full-wave rectifying tube, T_2, is used in the armature circuit, Fig. 2. This control is for operating shunt or compound dc motors up to ¼ hp on 115- or 230-v ac systems. Motor speed range is usually 10 to 1 or 15 to 1. The control is also equipped for reversing the motor and for dynamic braking where quick stopping is required. A time-delay relay prevents loading the rectifier tube until its cathode is heated. A magnetic overload breaker *OL* with time delay protects the rectifier tube from excessive starting current.

Time-Delay Relay. When power is applied to the control, transformer *AT* is energized, as indicated by arrows. Cathode-heating secondary *S* supplies current to heat the cathode of rectifying tube T_1. A pilot lamp connected across the cathode shows if this circuit is energized. The motor-field circuit is also energized through one arm of the selenium rectifier, the field windings, and again the rectifier to the + line.

A time-delay relay *TD* connected across the line prevents anode voltage being applied to the rectifying tube until 40 sec after the cathode is energized, to prevent damaging the tube. If power is off for less than a second, contact *TD* opens and the relay will recycle, thus protecting the rectifying tube against voltage interruption.

The relay will not open on short voltage dips so prevents needless service interruptions. Its timing element is in series with the fuse so armature power cannot be supplied unless the field coils are energized and the relay times out.

Starting the Motor. When time-delay contact *TD* closes, transformer winding *AS* is energized. For the polarity shown, current flows from the center tap *T* through the armature and top half of winding *S* to the cathode and bottom anode from *A* to *B* in the transformer and to + line. A secondary current flows from *T* through the armature with the primary current, but from *B* to *T* in the transformer. On reverse line polarity, top anode of tube T_1 comes in service for full-wave rectification.

Armature current goes through a reactor and a 3-position reversing switch *RS*. The former serves as a filter to smooth out the ripples in the rectified current. Throwing the reversing switch from one running position to the other changes current direction through the armature for reverse rotation. In its off position the switch closes contacts *C* and *D* and C_1 and D_1 to connect dynamic-braking resistor *R* across the armature to stop the motor quickly. This switch cannot be thrown quickly from one running position to the other. A short delay is necessary at the mid-position, before it can be closed, to prevent a sudden reversal of power in the armature.

Tap *F* on the transformer permits voltage adjustment for 230-v across the field coils. Field excitation can also be reduced to obtain speeds above base value. Turning a single rotary switch changes the tap on the transformer to adjust armature speed.

Electron-Tube Control. Fig. 3 diagrams a General Electric fractional-horsepower dc-motor control in which armature and field currents are supplied by gas-filled tubes T_1 and T_2. Tube T_1 is a grid-controlled half-wave rectifier in the armature circuit. Speed control with this unit is by armature current only, from low to motor-rated value.

Tube T_2 is a full-wave rectifier that excites the motor's shunt field and supplies the signal voltage for the speed-control circuits. Contactor *M* and overload relay *OL* provide undervoltage and thermal-overload protection for the motor. Power is supplied to the armature of the motor directly from the 220-v line.

Transformer primary *PT* has four secondary windings. Two of these, S_1 and S_2, heat the cathodes of tubes T_1 and T_2, respectively. A third winding, S_3, provides an ac signal to the phase-shifting network in the grid circuit of armature-power tube T_1. The fourth secondary, S_4, supplies 275-v power to tube T_2 for constant excitation of the motor's shunt-field winding and the dc bias on the grid of tube T_1. As will be seen later the reason for this high voltage on the shunt-field winding is that resistor R_4 is in series with this winding. This resistor supplies a minus dc bias to the grid of tube T_1.

Control signal applied to the grid of tube T_1 includes an ac rider voltage from secondary S_3 and a dc voltage from speed-control potentiometer *P*. Voltage across the potentiometer is obtained from the shunt-field rectifier and is filtered by resistor R_1 and capacitor C_1.

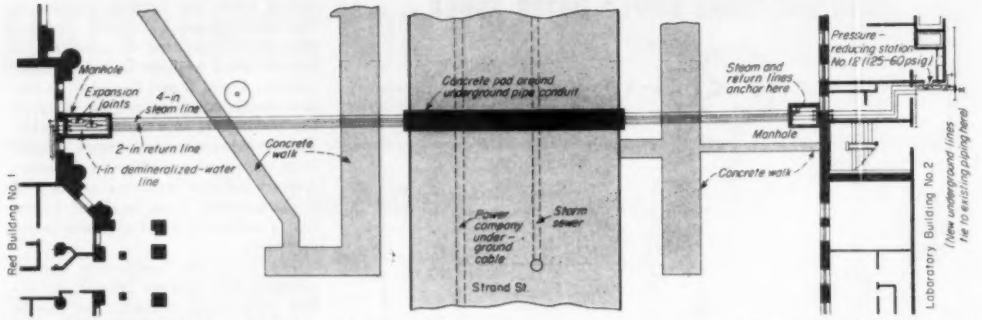
The dc voltage from potentiometer *P* shifts the ac rider in a positive or negative direction to control the point in the anode voltage wave where tube T_1 conducts. In this way power supplied to

(*Continued on page* 192)

CREDIT...

. . . is due the paper, *Power Plant Operation with Hot Lime-Zeolite Process*, No. 50-A-77 (presented before the annual meeting of the ASME, New York, Nov 29-Dec 1, 1950) for the material making up the article, "Hot Lime Proves Practical," p 110, March POWER.

HERE'S WHERE UNDERGROUND LINE WAS RUN, AND HERE ARE . . .



LOOP CONNECTION between Red Building No. 1 and Laboratory Building No. 2 passes under Strand St, main traffic artery

Underground Piping Problems Solved

. . . by new method of construction. Installation at University of Texas combats corrosion and leakage, is flexible and economical

By Wm J Whatley*

► UNDERGROUND PIPING always poses problems. These proved tough when the University of Texas extended and modernized its Medical Branch at Galveston. Here, buildings are only a few hundred feet from the Gulf. Ground water, always present approximately at the grass roots, is highly saline. Soil is mostly sand, with clays and other materials at depth. And the area is subject to flooding so any underground conduit system must permit draining manholes and conduit after such flooding.

Why Underground? Need to put steam-distribution piping underground came about thus: As part of over-all extension and improvement, the boiler plant, laundry and water-treatment facilities, and steam-distribution system serving some 25 buildings were extensively revamped. Distribution to the east could be handled overhead, in arcade ceilings connecting the buildings. On the west, however, a loop connection was needed between Red Bldg No. 1 and Laboratory Bldg No. 2 (*above*). This would have to cross Strand St, a main traffic artery in center of entire Hospital group. The street could not be closed entirely for construction; an overhead system would impair the buildings' appearance, interfere with traffic and require excessive headroom.

The engineers decided to go underground. The lines emerged from basements of both buildings. An expansion manhole was put in at the north end and an anchor manhole at the south. Three lines were involved: 1-in. aluminum line carrying distilled water from boiler-plant demineralizing station to Lab Bldg; 2-in. wrought-iron line for high-pressure returns from drip stations in Lab Bldg; and 4-in. sched-40 black-steel line carrying 125-psig steam to Lab Bldg, where it connects into the main distribution through a 125-60-psig pressure-reducing station and completes the steam-distribution loop.

Construction. The system chosen has seen service a number of years under severe conditions in the Gulf coastal area. As described on facing page, it employs an exterior casing of transite pressure pipe, with joints made by transite couplings having rubber ring gaskets. These casings are 4-, 6- and 10-in. diam, in this case. Within the casing, pipe is centered and held against thermal thrusts by refractory supports of special design. These provide openings for ventilation and draining. After a flood, for example, entire conduit system can be drained and insulation dried while in service. In normal service, air induced in the system ventilates insulation, preventing mold and mildew prevalent here because of high humidity.

Usually this underground-piping system is installed on a slight grade to facilitate drainage. Because of interference and minimum amount of cover under the street, it was not possible on this job. Conduit under the street carries a protective concrete cover installed after the conduit system was completed and in place. All conduit lines are level. From each manhole, drains connect to a storm sewer under the street.

Expansion joints (Yarway Gunpakt type) are used on steam and return lines, bolted to concrete bases in the north manhole. Lines are anchored by welding to an I-beam in south manhole.

Advantages claimed for this construction include: (1) It resists electrolysis, corrosion, and attack from acid waters. (2) Tight seals prevent groundwater leakage into casing. (3) Casing and structure has high flexural strength. (4) Materials, with possible exception of rubber rings, can be removed, reused. (5) Light weight of casing and other parts makes for easy trench assembly, lower handling cost.

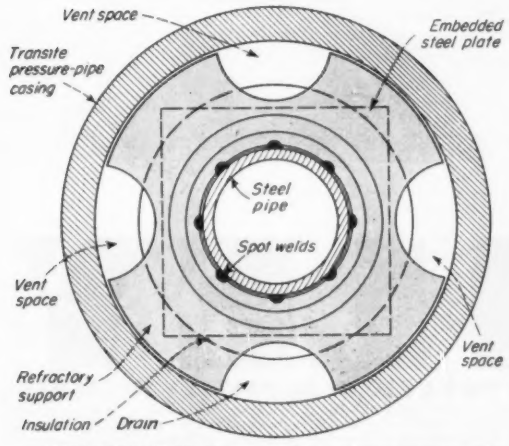
All mechanical work at University's Medical Branch is under supervision of Carl Eckhardt, prof of mech engrg and supt of utilities, in Austin, Texas. Consulting engineers are Freese, Nichols & Turner of Houston; mechanical contractor is The Farwell Co, Inc, of Dallas.

*Now mechanical engineer of Wyatt C. Hedrick, Houston, Texas. Whatley was mechanical engineer for Freese, Nichols & Turner at the time this installation was made. He is designer of the construction system described here and holds patents on it.

. . . BASIC CONSTRUCTION ELEMENTS AND HOW THEY GO TOGETHER

SITE ASSEMBLY: Refractory supports are welded to the pipe. Pipe is coated with rust-inhibiting paint and insulation applied. Sections of pipe are then lowered into trench and welded together. Waterproofing is applied over insulation

PIPES IN TRENCH show several steps of assembly. In front are partly insulated sections with refractory supports. At rear, exterior transite casing has been slipped into place. The transite couplings with rubber ring gaskets can be seen



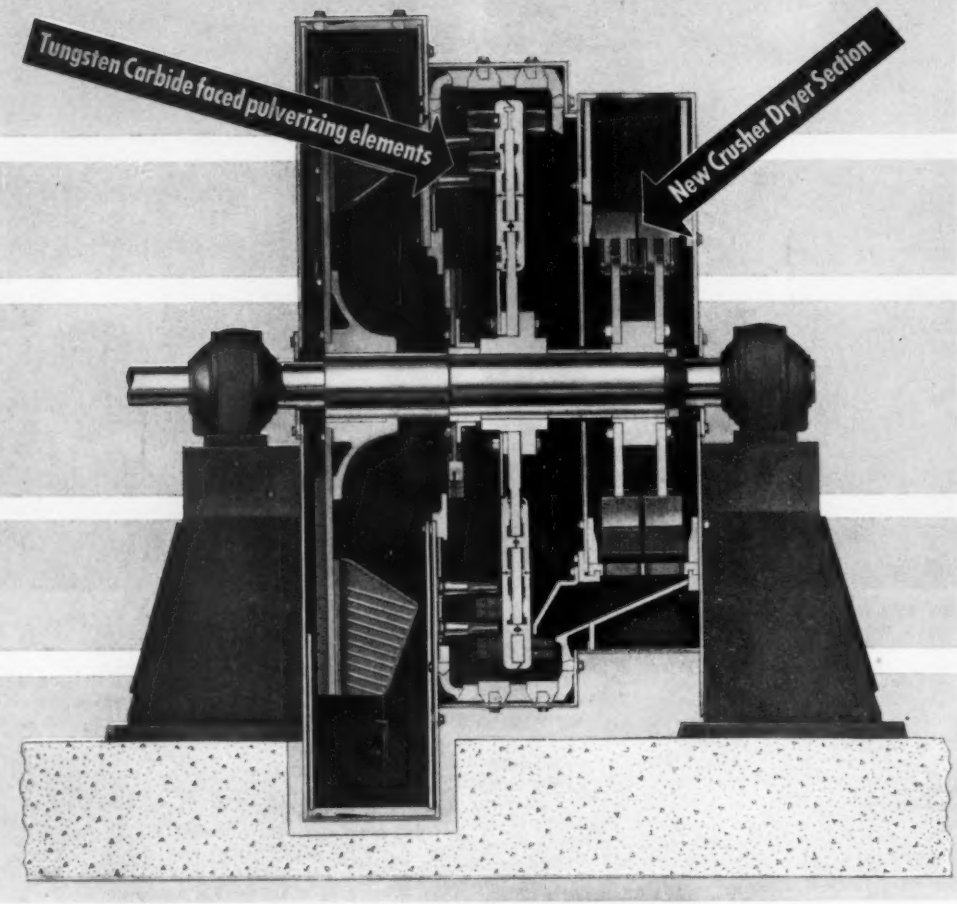
REFRACTORY SUPPORT centers pipe in asbestos-cement casing, provides openings for venting and draining the pipe conduit

Refractory supports center interior "working" pipe in exterior transite pressure-pipe casing. With wrought-iron or steel interior pipe, refractory support has a steel plate imbedded in it, so support may be welded to pipe. With nonferrous tubing, steel plate is omitted and a plain refractory support with opening of proper size is used. Refractory is a high-strength castable unaffected by heat or cold, and acidproof. It will support any thermal movement of pipe.

Support has semicircular openings 90 deg apart. Upper three ventilate the system to avoid mildewing of insulation and similar troubles. Bottom opening serves as a drain for condensation that may develop or for water entering the system under flood conditions.

In assembly, refractory supports are placed on pipe and welded. Pipe is coated with rust-inhibiting paint and insulated. Pipe sections are welded together and the outside casing slipped over the supports. After weld tests and insulating of joint areas, couplings are pulled into place. These couplings are also made of transite, fitted with rubber ring gaskets capable of withstanding an internal pressure of 500 psi. With couplings in place, exterior casing seals against ground water. Transite casing sections are both pressure and beam tested. Using commercial casing lengths, conduit sections are usually 13 ft 6 in. center-to-center of joints.

This new Riley Pulverizer gives you



TRADE MARK Rx REGISTERED

RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston · New York · Philadelphia · Washington · Buffalo · Pittsburgh · Cleveland · Detroit · Chicago
Cincinnati · Atlanta · New Orleans · Memphis · St. Louis · Kansas City · St. Paul · Tulsa · Houston
Denver · Salt Lake City · Los Angeles · Portland · Seattle

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS

these added significant advantages

No capacity reduction with increase in moisture.

In the crusher dryer section where coal is crushed to a fine granular state, approximately 40% through a 50 mesh screen, representing about 5% of the work to be done, free moisture is evaporated from coal. The crusher dryer section acts as a flash dryer. Coal then enters pulverizing section where 95% of the work is done, completely free of moisture which would affect pulverizer performance and capacity. The crusher dryer section is designed with ample capacity for the highest moisture coals and as moisture is evaporated before coal enters the pulverizing section, moisture has no effect on pulverizer capacity or performance.

Tramp iron, iron pyrites and other foreign materials in coal rejected.

The crusher section of the pulverizer rejects tramp iron, iron pyrites and other hard foreign substances in the coal, preventing any materials from entering the pulverizer section which could cause damage.

Pulverizing elements faced with tungsten carbide.

Pulverizing elements are faced with tungsten carbide, assuring long periods of service without outage for maintenance and resultant low maintenance costs. Numbers of Riley pulverizers equipped with tungsten carbide faced parts have been in operation over two years without showing appreciable signs of wear, indicating at least several additional years of service before replacements are necessary. Over 50,000 tons of coal have been pulverized by a mill having a six-ton per hour capacity with indications that well over 200,000 tons will be pulverized before requiring replacement.

Fineness sustained over years of operation.

Because the life of the tungsten carbide faced pulverizing elements is so long, fineness of pulverization is maintained over years of operation. Tests on existing installations show no falling off of fineness after over two years of operation. No adjustments are necessary to maintain fineness.

Unusually high capacity per unit of space.

The improved Riley pulverizers have an unusually high capacity per unit of floor space and height, permitting their installation under crowded space conditions. A Riley Pulverizer having a capacity of 20 tons per hour with 50 grindability high moisture coal is only 11′9″ wide, 10′0″ deep and 7′6″ high and weighs only 46,780 lbs. Because of their lower weight and quiet vibrationless operation, heavy foundations are not required.

If you are interested in coal pulverizers, we believe you will find the article "THE USE OF TUNGSTEN CARBIDE IN COAL PULVERIZERS," presented at the fall meeting of the A.S.M.E., well worth reading. We will be happy to mail a copy to you without charge on request.

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

Keep your eye on V-P-I WHEN SELECTING BLOWERS

CENTRIFUGAL

Motor-driven Type OIB Centrifugal Blower in chemical processing plant. Capacity 19,000 cfm.

Wet lunk is blown 400 feet, from charger to stacker, by R-C Rotary Positive Blower in this Nova Scotia paper mill.

ROTARY

You can't afford to risk shutdowns today because of unsatisfactory or inadequate equipment performance. To keep production moving at the required fast pace, calls for blowers or gas pumps that continuously deliver positive Volume at required Pressure—and at Low power costs to reduce operating expense.

You get these 3 essentials from R-C Blowers and Gas Pumps. Whether your needs call for Centrifugal or Rotary Positive units, we can match them from our exclusive *dual-ability line*. With capacities from 5 cfm to 100,000 cfm, you can usually find R-C units that closely fit your demands, with resultant savings in time, cost, space, weight and power.

From an experience of almost a century of blower building, our engineers will gladly make suggestions of the right R-C equipment to move or measure gas and air to keep production going.

ROOTS-CONNERSVILLE BLOWER CORPORATION, 510 Powell Avenue, Connersville, Indiana.

ROOTS-CONNERSVILLE

BLOWER BUILDERS SINCE 1854

ONE OF THE DRESSER INDUSTRIES

This supply line is geared for your stepped-up production

AMERICA REARMS. This rearmament program undoubtedly means that your plant has, or will have, a greatly stepped-up production schedule. And with new machines and new operations, new lubrication problems are created.

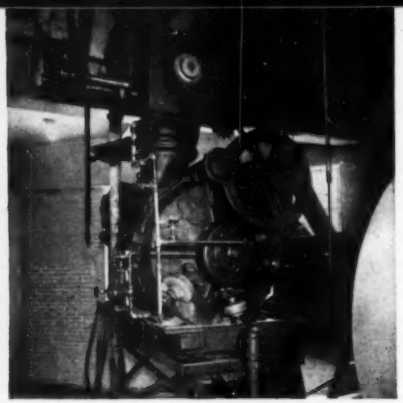
That's where we come in. A Standard service-supply center is near your plant. Any petroleum product you need can be delivered to your door within a few short hours. You need never worry about production delays, and you can avoid the expense of stocking large supplies of lubricants and fuels within your plant.

Your nearby Standard service-supply center is your always-dependable Supply Line. It is also headquarters for a Standard lubrication specialist, a man specially trained to give you expert and thorough advice on any lubricating problem, is also available through this service-supply center. His services, along with Standard Oil's efficient supply service, can help your important production go like clockwork.

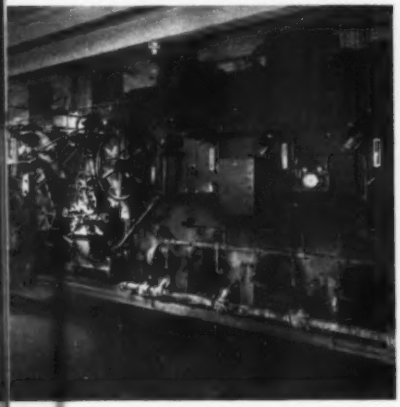
To arrange for a visit from your nearest lubrication specialist, phone your nearby Standard Oil service-supply center or write to: Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY (INDIANA) STANDARD

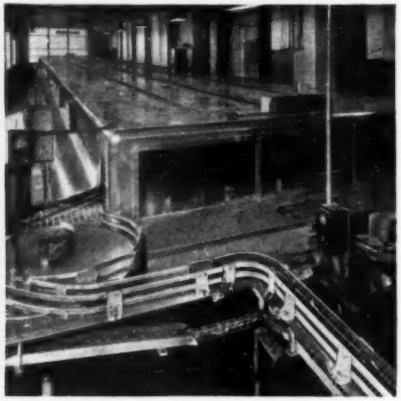
Keg scrubber – A constant stream of water at 130°F. plays over these barrels and reaches bearings on conveyor.



Wet-grain press–After being heated to 180°F., grain is then pressed dry. Hot water comes in contact with bearings.



Bottle soaker and washer – Bottles are first cleaned with strong alkali at 180°F., then washed with water. These conditions make bearing lubrication difficult.



Pasteurizer–Beer is pasteurized in this modern machine which is subjected to constant water spray ranging from 80°F. to 140°F.

No trouble brewing for bearings!

A midwest brewing plant employed seven different greases in a variety of applications. Despite the use of these special products, the operators experienced difficulty. The greases would not withstand both water and high temperatures. Frequent applications were necessary.

A Standard Oil lubrication specialist was called in on this problem. Upon his recommendation, STANOLITH Grease—a lithium-soap product with the ability to withstand both heat and water—was given the job.

As a result, STANOLITH has replaced all seven greases formerly used and *has done a better job in each type of application.* Through its use over a two-year period, grease consumption has been reduced 20% and time spent in applying grease cut 50%.

STANOLITH Grease can prove its remarkable versatility in your plant, too. Its high mechanical and chemical stability plus its extreme resistance to heat and water qualifies it to replace a variety of special greases.

STANOLITH
TRADE MARK
Greases

To obtain maximum benefits from STANOLITH, use the services of a Standard Oil lubrication specialist. His headquarters are near your plant. How you can benefit by his on-the-spot service is explained at the right.

Standard Oil Company, 910 South Michigan, Chicago 80, Illinois.

What's YOUR problem?

Mr. D. V. Wills of Standard Oil's South Bend office is the lubrication specialist who helped this Midwest brewing company solve a difficult lubrication problem.

He is one of many Standard Oil specialists located throughout the Midwest. These men have the practical experience and special training to handle lubrication problems on any type of operation.

Take advantage of the service offered by the lubrication specialist nearest your plant. You can reach him by phoning your local Standard Oil Company (Indiana) office. Why not call, today, and arrange to discuss with him the advantages offered you by STANOLITH and other outstanding products such as:

STANOIL Industrial Oils—This general-purpose line of oils provides cleaner operation of hydraulic units and supplies effective lubrication in compressors, gear cases, and circulating systems. One or two grades can replace a wide variety of special oils and lubricants.

SUPERLA Greases—Available in a wide range of consistency grades and in both lime-soap and soda-soap types, SUPERLA Greases cover a wide range of applications. These efficient products are comparable in quality with the highest type of special greases.

STANORUST Rust Preventives—The eight grades of STANORUSTS form one of the most complete and effective lines of rust preventives on the market today. Each has been scientifically developed for its intended use. The grades range from a fingerprint remover to a heavy petrolatum that protects against corrosion for years under the most severe outdoor exposure.

STANDARD

STANDARD OIL COMPANY (INDIANA)

Reading for Profit

FROM STEM TO STERN this new POWER is designed to help power engineers get ahead—all kinds of power engineers in all kinds of plants, everywhere.

In short this is now a very broad book, giving equal weight to the professional and the practical sides of power production and use.

For easy finding we are keeping these phases sharply separated, with *Engineering and Management* up front, followed by *Plant Operation and Maintenance*, and then by the newsy material in the Reader Service Section. The first is the POWER long familiar to many engineers. The second is OE as you knew it. I think you will agree that each of these sections is doing the job you have learned to expect and respect.

Getting them together under a single cover should be helpful to the many thousands of engineers who want to learn the whole power job—the men who are not satisfied merely to plan, or merely to do, the men who aim to become complete power engineers.

Whether your prime interest is in *Engineering and Management* or in *Plant Operation and Maintenance* you can find much profit in studying the other half of the power job as far as your time will allow.

I don't mean that every OE reader should necessarily set out to read every article in the front of the book. But I do mean that there is "gold in them thar hills" if you will do a little prospecting.

Some articles in the *E & M* section will offer information or advice of immediate use on your particular job. Others will tip you off on new developments. And, if you are running a small plant, it will pay to read some of the big-plant articles. Many a big-plant idea will work as well in a small plant.

The same kind of advice holds for the former POWER reader. He can read *Plant Operation & Maintenance* either to keep his hand in (if he has a practical background) or to get a better feel for the problems faced by the men who keep the wheels turning.

Whichever way you cross over you can't lose by this wider reading. The combination of practical and professional knowledge is the sure key to success in the power field.

So far I speak from your personal angle. In addition I think that we all can find satisfaction in the fact that this new POWER has about 47,000 subscribers—by far the largest number the field has ever known. That means that this great body of engineers, plus many pass-along readers are now exposed to the broadest kind of education possible in the generation, transmission and application of all the power services.

This should make for better understanding among all the engineers involved. Each man will know more about the other fellow's job. Teamwork should improve to the advantage of all concerned.

If you have any comments, or can think of any way to improve our service to you, please write in and be assured that your letter will be given real attention.

Phil Swain

Mike's Got a Sweet-Running Power Plant!

We've been hearing things about Cleveland Graphite Co's power plant. Modern equipment, up-to-date operation, pleasant working conditions, and a grand gang to blend it all into a winning combination. To get the facts Associate Editor Jim O'Connor took an electronic recorder and went to work with operating engineer Mike Yunich. Join in as we look at Mike's plant

"BEFORE STARTING our tour, Mike, sit back in your chair and give us an overall word-picture of your power plant."

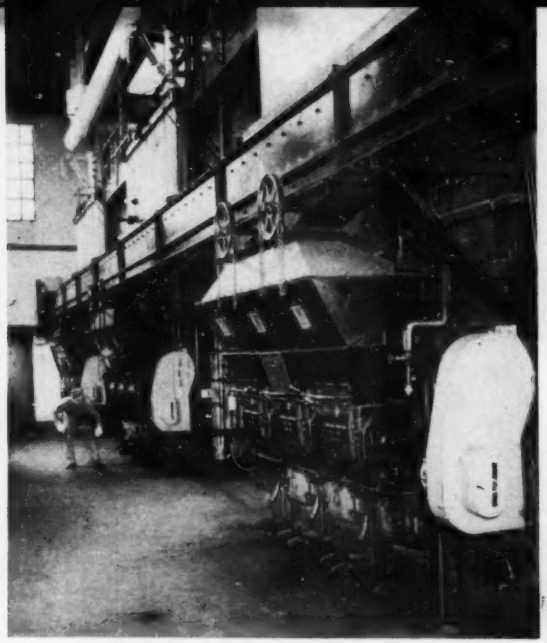
"WELL, JIM, our job is to produce steam and compressed air. We buy all electricity from the local utility. The steam is used for process and building heating in the manufacturing plant you see through that window. We have three boilers, with spreader stokers, each capable of generating 28,000 lb of steam per hr.

"We stock-pile about 3000 tons of coal out in our yard. Our coal supply is brought in on railroad cars and trucks.

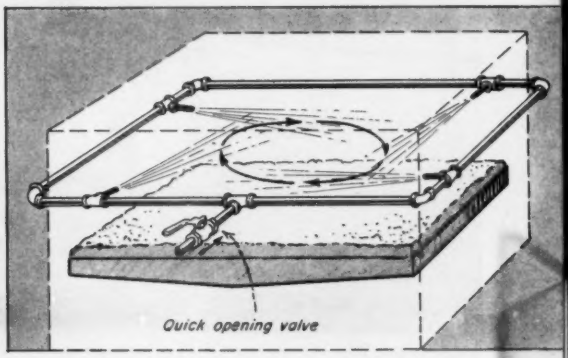
"Total capacity of our 5 air compressors is 5300 cfm. Now let's step out on the boiler-room floor, Jim"

"DO YOU FIND 'economy-reminders,' such as this coal-saving calculator, really effective?"

"DEFINITELY YES. Then again I feel we have an outstanding gang of fellows here. For instance, out of the 13 men I have working for me, 9 have taken study courses on their own time. Top management pays half the tuition fees"



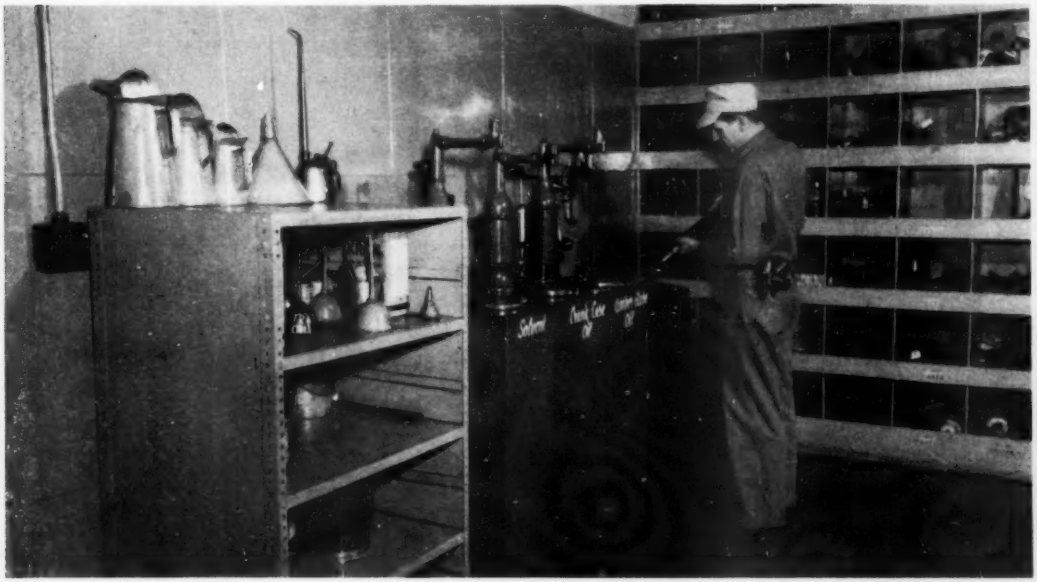
↑ **THESE CLEAN STACKS RESULT FROM THESE JETS** ↓



"MIKE, HAVE YOU ever wrestled a smoke problem here?"

"AND HOW! Back in 1940 while the plant was being built we used steam from a locomotive. You see the boilers weren't ready so the locomotive was with us for about two months. She let out smoke galore. This put us in bad with neighbors.

"And frankly, even with our modern equipment we still had a smoke problem after the boilers went into service. I took the bull by the horns and tried sticking an air hose through the side observation door over the firebed. Sure enough, this reduced the smoke. Compressed air gave way to steam jets. Then the boiler manufacturer suggested 4 jets as in above sketch. We've been at peace with the neighbors ever since"



"SPEAKING OF MEN, does that lad handle all lubrication or is it passed on to a separate man on each shift?"

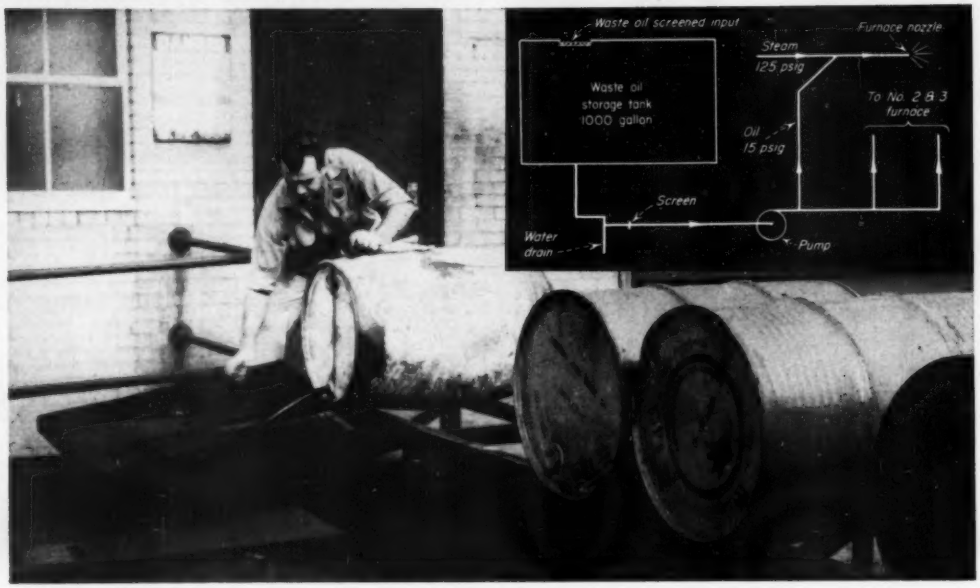
"HE HANDLES IT ALL. I'm a believer in fixing responsibility. I broke him in by showing him how each machine should be lubricated. Then I explained the importance of his job—how all rotating equipment depends on oil film for bearing life

"I feel it's a mistake to take the lowest man on ladder-of-importance and shove an oil can in his hand. A good oiler should know lubrication fundamentals and equipment."

"HAVE YOU a lubrication schedule set up?"

"YES, AND IT TAKES in regular daily, weekly, monthly and yearly plans for lubrication of all equipment"

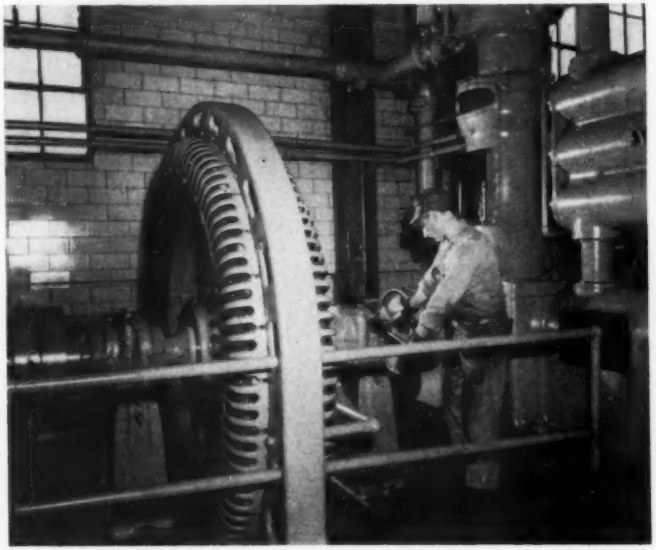
Continued next page



"HOW DO YOU HANDLE old oil and general plant waste?"
"ALL WASTE from the manufacturing plant is burned in our incinerator. Heat developed is transferred to boiler feedwater. And that oil you see being dumped is burned in the main boilers.

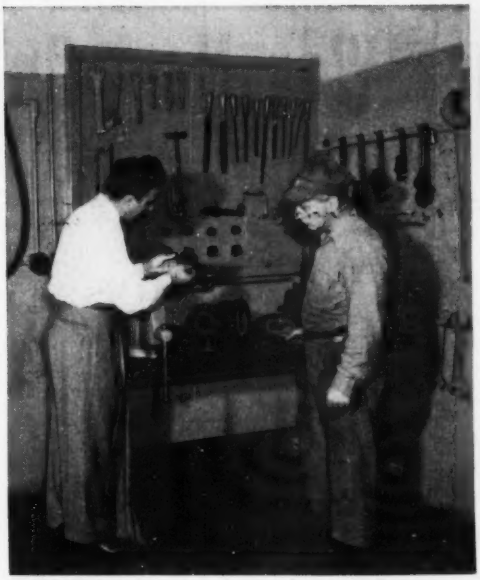
"Originally we stored the waste oil and every so often paid to have it hauled away for disposal. But when waste oil built up to 15,000 gal a year this became expensive. Now we dump it all into an underground storage tank and burn it on peak-load periods.

"When burning waste oil we drop an air line into the storage tank to mix the oil. This keeps heavier oils from settling out. By burning oil we save 60 tons of coal a year"



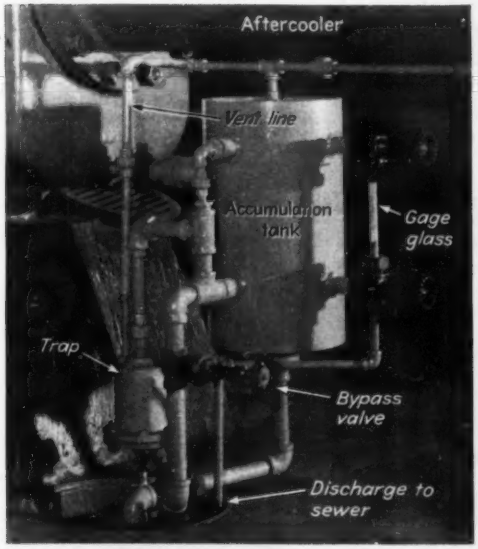
"IS THAT FELLOW SPLITTING the coupling between motor and air compressor to take half the unit out of service?"
"RIGHT! We use compressed air on the production machines in the manufacturing plant. I picked up that baby from another plant during the war; we couldn't get a new one. That separating feature fits well in our maintenance and production schedule since we can knock off half and put the other section back to work"

There Are 7 Practical Tips in This Story. Why Not Use Them in Your Plant?



"NEAT REPAIR shop, Mike. How big a job will you tackle?" **"TO DATE,** we handle **all** our own repairs. Generally the only repair jobs we let out are motor rewinds. And since we haven't a separate electrical team in our 13-man operation, we pass on all wiring jobs to the electrical maintenance department in the manufacturing plant"

"WHAT ARE YOU DOING on stoker part atop that bench?" **"WELL JIM,** we find certain parts of our stokers and conveyors take quite a beating. So to prolong equipment life we make up for wear by metal-spraying. We find we get years of additional life by spraying the stoker's feeder rolls and side plates; conveyor sides too. Sprayed metal wears well"



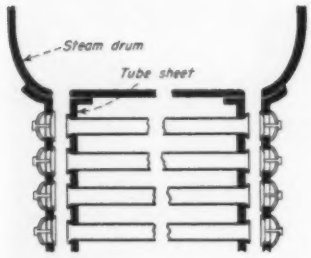
"THAT ACCUMULATOR looks like a new addition. Why?" **"ON HUMID DAYS** I found the aftercooler trap would sometimes stick. In the original design there was little space for water accumulation. We were only sure the trap was operating when we tried the bypass blowdown. Now with the added storage space and sight glass we can spot a stuck trap"

"HERE'S AN EMERGENCY LIGHTING RIG. How would you cope with a major electrical-power interruption?" **"IN THE POWER PLANT** we have several storage-battery floodlights plugged into outlets. They go on automatically if the electricity fails. However, in the manufacturing plant we have a gasoline-engine generator for emergency lights"

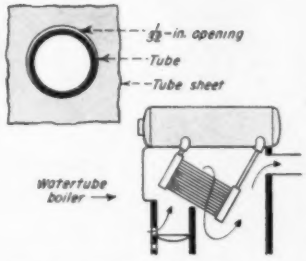
OPERATORS' NOTEBOOK 41

Declare War Now On

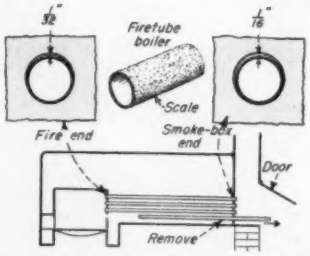
WHY TUBES ARE ROLLED



BOILER TUBES are expanded into tube sheets to seal opening around tube and to stay tube firmly in its position

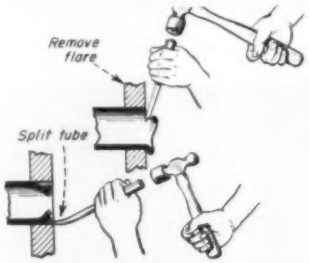


NEW WATERTUBE BOILER, has about 1/32-in. clearance between tube and tube-sheet hole at both ends of the tube

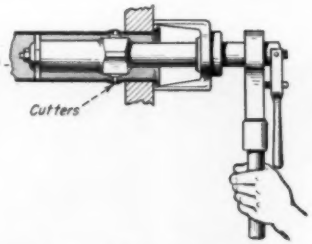


FIRETUBE BOILER tubes become scaled on outside. To help remove tube, clearance is 1/16 in. at end shown

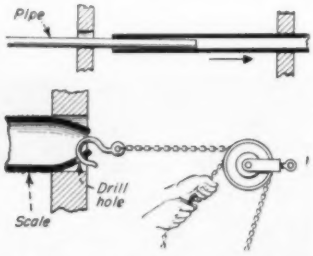
HOW TO REMOVE AND ROLL



TO REMOVE TUBE, chisel off flare, flush with tube sheet. Then split tube with diamond point chisel like this

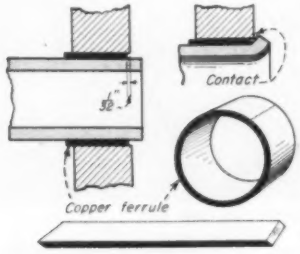


CUT BOTTOM-ROW TUBES inside tube sheet with cutter so they drop into furnace. Collapse and remove ends

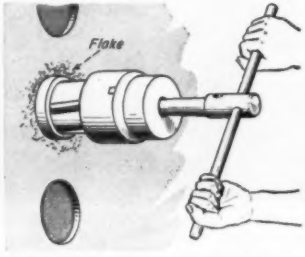


SUPPORT LONG TUBE with pipe. If tube is badly scaled, drill hole in collapsed end and pull with chainfall

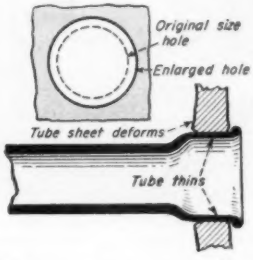
DON'T OVERROLL



OUTSIDE FERRULE fills loose space around enlarged holes. Buy, or make from thin copper sheet; use as shown



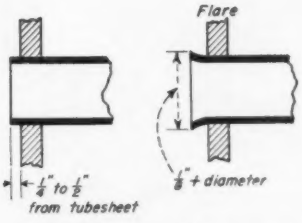
UNDER-ROLL, never over-roll tubes. Roll slowly and STOP when tiny flakes start leaving tube sheet around the tube



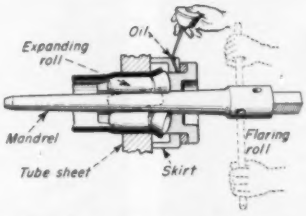
OVER-ROLLING enlarges and deforms tube sheet. Tube is thinned and weakened inside tube sheet to a dangerous point

Sloppy Tube Rolling!

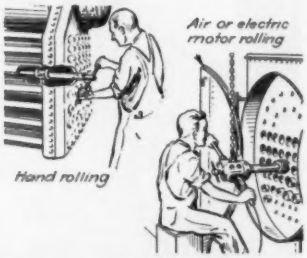
By **STEVE ELONKA**, *Associate Editor*



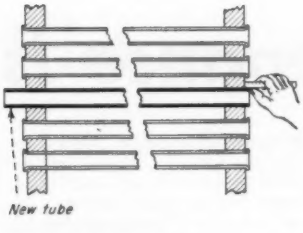
ASME CODE requires ends of watertube boiler tubes extend ¼ to ½ in. and flared ⅛-in. dia larger than tube



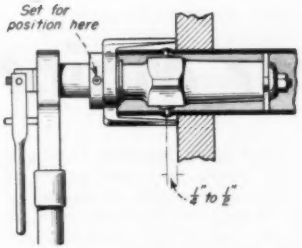
FLARING is usually done with tube expander that has belling or flaring rolls, with skirt to control flare depth



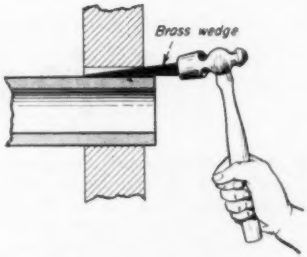
EXPANDERS are hand or motor operated. Hand rolling is harder work but there's less chance of damaging costly tubes



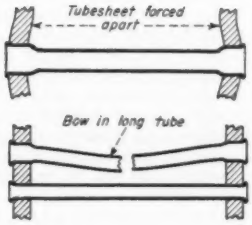
BEFORE INSTALLING new tube, check tube-sheet hole for damage. Stick in new tube and extend ¼ to ½ in. on ends



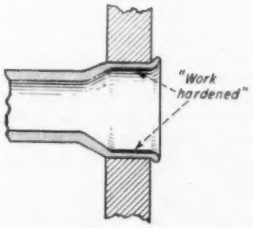
CUT TUBE at other end with inside tube cutter. If no cutter, mark tube in place (remove before wedging), and saw



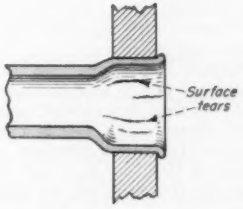
TO HOLD TUBE in place while rolling one end, drive thin tapered brass wedge between tube and tube-sheet hole



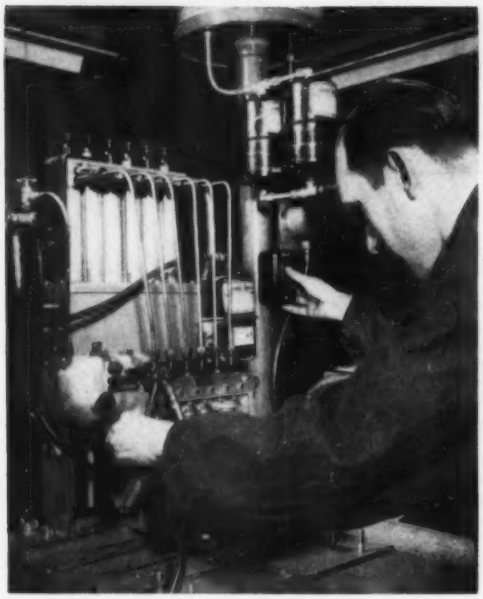
OVER-ROLLING forces tube sheets apart. Long tubes of small diameter bow, then collect sediment and bag-fail



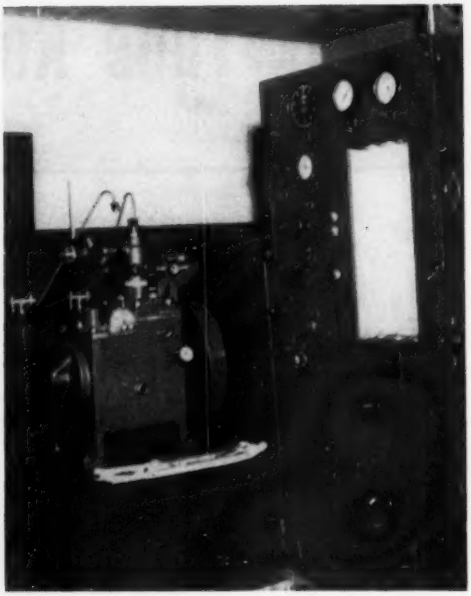
OVER-ROLLING 'work hardens' inside of tube at tube sheet. Hardness makes metal brittle and causes early failure



OVER-ROLLING causes surface tears inside rolled part. Tears weaken tube in time and again cause early failure



TESTING fuel governor attached to en-bloc-type fuel pump. This highly specialized test equipment does the job right



INDIVIDUAL-TYPE FUEL-PUMP test apparatus measures oil pumped into calibrated glass tubes. There is no guesswork

Injector Maintenance Is

► A MAINTENANCE MAN'S success often depends more on what he has sense enough to leave alone than on what he tears apart. It's easy to get in over one's head with unfamiliar machinery. Then too, with modern equipment, special tools are often needed.

Injection equipment is a good example. It's simple to take an injector apart but not so easy to get it back together so it works right. Now it's not that there's anything very mysterious about injectors. It's just that fits are closer there than in most mechanical assemblies. That's why each part's duties must be thoroughly understood. Then again special tools are needed for calibration and timing.

Injectors. If you don't keep injector parts clean there's more damage and wear than from thousands of operating hours. Here's a first rule to paste in your hat: Don't take assemblies apart just for a "look-see" and never unless hands, benches, tools, etc., are "hospital clean."

Because of important job injectors do, they need more attention and are so designed. Here are things to do.

Check Spray Tips First. Carbon deposits interfere with spray pattern and plug the orifices. Clean external deposits by scraping carefully. Use a brass-wire brush. After removing tip from the injector body, scrape inside or ream with special tools supplied by manufacturer.

Single large orifices offer little problem but the holes in multi-orifice types (down to 0.006 in.) are more critical. Soak the tip in Stoddard solvent first (Jan. *OE*, page 36-37). Use short length of piano wire, held in a pin chuck for final cleaning. Wire should be slightly smaller than hole diameter, but watch out for burrs. The trick is to completely clean the orifice without enlarging or damaging it in any way.

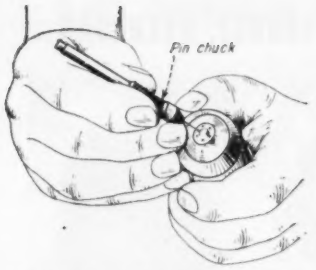
Injection nozzles are of various designs, but most popular type is the differential spring-loaded injector. The commonest troubles are sticking and leakage.

Sticking may be due to gumminess from fuel, or from small cracks due to heat; distortion from overheating; or dirt.

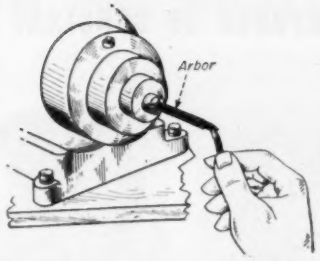
If not too bad, solvents under light pressure will generally free the needle. Minor distortion, galling, abrasion, etc., that does not affect the full length of needle or bore can sometimes be corrected by a very light lapping. Excessive leakage of the high-pressure fuel past the stem reduces injection pressure. How do you tell a bad case of leakage? Well, if you need excessive force or if needle won't budge—brother, you've had it.

Seat leakage is next job. Minor leakage can often be stopped by lapping needle very lightly on its seat. Use only diesel fuel for an abrasive. If fuel won't lap it in, you have a job on your hands. First, check needle where taper runs out to the small diameter. If this shoulder is eroded or has appearance of numerous small cracks, the needle is shot. Chances are, the seat is shot also. Look at the seat with a low power microscope, or a strong magnifying glass. Then you can decide if seat can be restored or should be replaced.

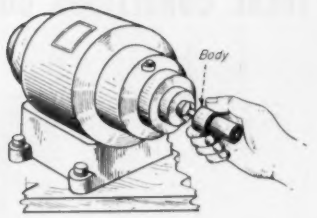
Seat repair is a lapping process. For lasting results, lap with a cast-iron arbor and not with the needle. It's important to restore original angle. Needle-face angle and seat differed by ½ to



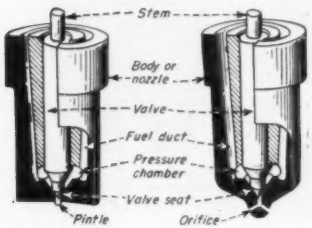
CLEAN NOZZLE TIP with wire held in pin chuck, but don't burr these holes



APPLY FINE COMPOUND to arbor tip and lubricate arbor shank with tallow



SLIDE BODY over revolving arbor and hold against seat for only 15 sec



INJECTOR PARTS fit very closely. Grit wears, so keep parts "hospital clean"

FOUR TIMELY TIPS

1 ***Don't monkey with fuel-oil-injector equipment unless you know how to do the job***

2 ***If you have no testing apparatus, send pump and injectors to authorized repair shop***

3 ***If you must overhaul equipment in a pinch, read manufacturer's instructions beforehand***

4 ***Before opening, remember that dirt causes more damage than ordinary wear does***

Tricky

By **JACK HAWTHORN,** *Chief Engineer*

1 deg when new. That shows original angle cannot be restored by lapping alone.

Suitable lapping bodies are available from equipment builders. You can also make them in a lathe. Arbor should fit bores of lapping body accurately. Mount arbor in a lapping lathe or head, then coat lightly with lapping compound. This is an abrasive of the flour class. Slide lapping body over arbor, taking care to keep abrasive away from bore. Incidentally, too much oil on stem may flood abrasive area. Then drawing abrasive into bore spoils precision fit.

First grind lightly to see if arbor face is at proper angle. If not, change it with a dead-smooth file. But be careful. Keep lapping until seat is cleaned up. With difference in face and seat angle, the ground seat will be a narrow ring. Lapping is an exacting process and requires a certain "feel" that can only be developed by practice.

After nozzle has been worked over, you need a nozzle tester. Once the spring tension is disturbed, it must be reset to the proper tension as specified for your injector. It's dangerous to run the engine with improper tensions. In addition to setting the popping pressure, you can make tests for leakage and proper operation (chatter test).

Injection Pumps. Now let's talk about injection pumps. First, the multi-cylinder en-block type. For timing the plungers (vertical positioning in barrels) you need an accurately graduated timing disc and pointer, as well as discharge-valve pullers, etc. To balance fuel delivery among the plungers (rotation with respect to the rack) you need a calibration stand and delivery data from the manufacturer.

Lacking this equipment, forget the job and send pump out for repair. Caution! First plug or cap all openings tightly. That keeps dirt out and cuts repair bills to a minimum.

The individual type pump is a different story. It's timed with pump mounted on engine and is pretty well understood. As for calibration, there are few injection repair shops with calibration equipment for pumps of this size. Replace suspected parts. Again, keep parts clean. Then calibration is usually correct within reasonable limits.

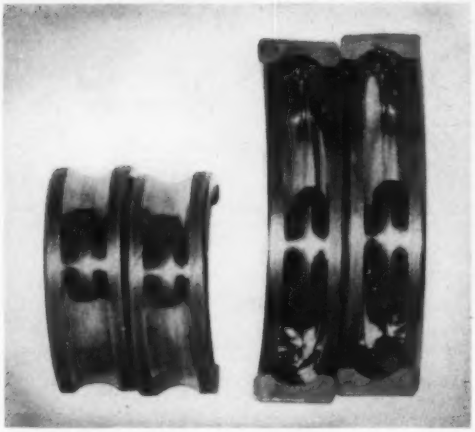
Balancing is generally done by adjusting linkage between control racks, so pointers on pump bodies give the same rack readings. These pointers are set at the factory during calibration. It's important that they are not removed, bent or otherwise damaged. If the engine is equipped with indicator cocks and the indicator is in good shape, use it for final fuel-balancing delivery to cylinders.

One trouble with this method of part replacement is that it takes fine judgment, based on experience, to know what part is to be replaced. It's easy to condemn a serviceable part to scrap heap and thus boost costs.

It might pay off in big round dollars to look up a shop with a calibration stand. Such shops are becoming more plentiful. Let them make test. Don't guess at part's condition.

These are some of major repairs on injection equipment. By now you can see that it's easy to get in over your head. A smart operator prepares for each repair he thinks he can handle. Then he sends more ticklish jobs like injectors out to a qualified repair shop.

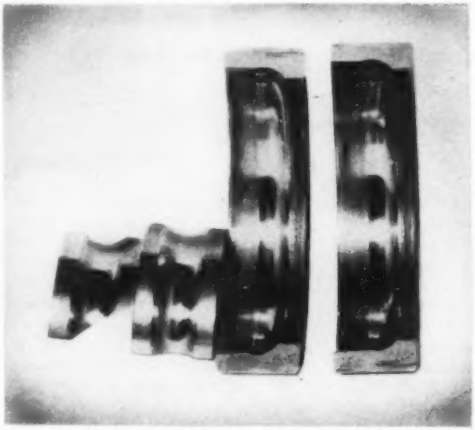
IDEAL CONDITIONS COMPARED TO CONSTANT THRUST, OVERLOAD...



THIS RADIAL BEARING has been carefully mounted and maintained. Ball path in polished races shows as dulled surfaces. Centered ball path shows uniform radial load, good alignment

BALLS didn't spin in angular-contact bearing. Reason: thrust load constant. Fatigue life of balls cut. Now if thrust load is removed you get rough, noisy operation

FATIGUE failure from overload. Starts in small area, spreads fast. Would affect races and balls in time; usually starts on inner race. Wide ball path also shows bearing overloaded



ANGULAR-CONTACT BEARING running under good conditions while carrying a pure thrust load. If radial-type bearing had carried this load its ball path would have been way off center

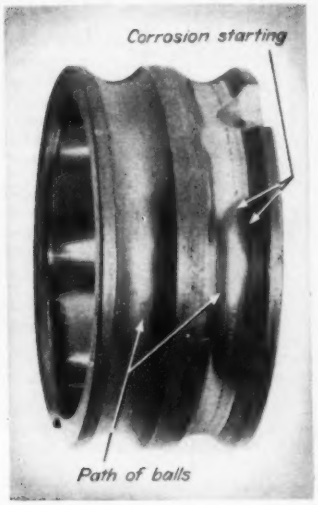
FAILURES CAUSED BY HEAT...

HEAT SOFTENS balls and races. And balls particularly, since heat cannot be conducted away as rapidly as from races. Then high centrifugal force causes the metal to flow as in above

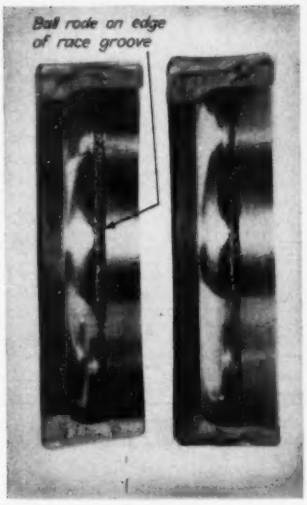
Why Ball Bearings Fail

Careless mounting and improper operation cause most ball-bearing failures. You can usually spot trouble-maker by examining bearing after failure. Photos by the Marlin-Rockwell Corp

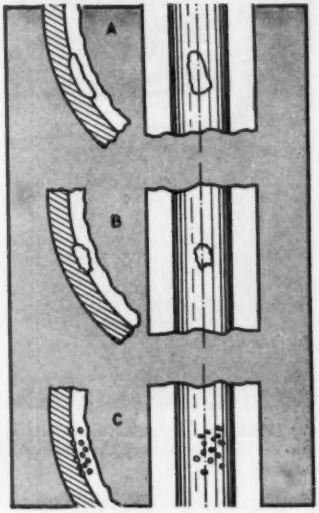
...RACE CORROSION AND THRUST APPLIED IN WRONG DIRECTION



CORROSION spreads quickly over entire exposed surface of race. It appears as a reddish brown coating coupled with a series of small etched holes. Consider this fact when you specify any equipment that operates in corrosive atmospheres

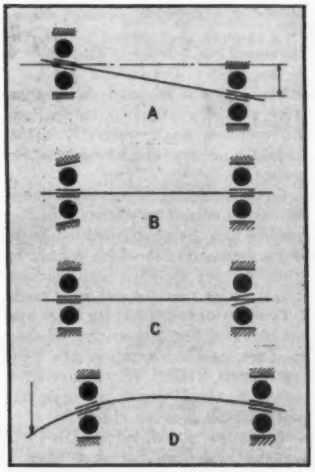


WRONG-WAY THRUST on this angular contact bearing forced balls to ride on edge of race grooves. This will break up the race surface. Under such operation balls often split even though material in the balls and its heat-treatment was good

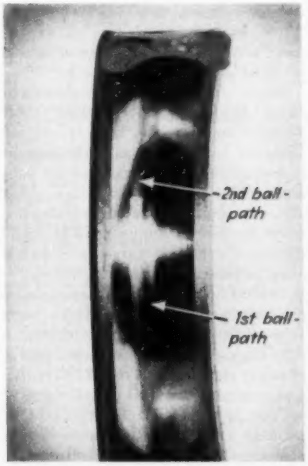


THREE WAYS to ruin race surface: (A) hard, coarse, foreign material causes gouges (B) overloads causes sharp, jagged edges shown here (C) corrosion made those rounded gaps. Action of balls often prevents corrosion from attacking ballpath

...AND BALL-BEARING MISALIGNMENT



MISALIGNMENT: (A) out-of-line shafts rarely cause trouble. Most single-row bearings can stand ¼-deg (B) bearing housing tilted (C) shaft shoulder tilts inner race (D) shaft deflection matters little; shafts are the weak link here

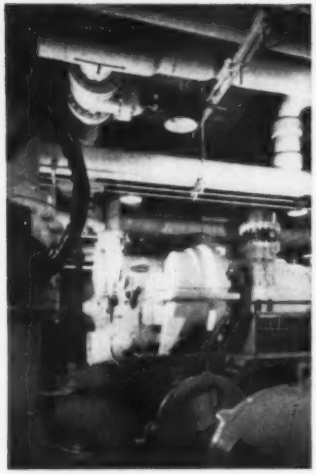


OUTER RACE forced out-of-line after it operated in good alignment. Note two operating tracts. In this case tilting was great enough to jam balls hard into race groove, starting fatigue failure; bearing took 3 deg tilt before jamming

RACEWAY POCKETS

CARELESS MOUNTING of bearing caused trouble; balls get flatspots. Hence the noisy "catchy" bearing sound. Failure occurs at ball's flatspots or races if thrust load lines up the ballpath and race dents

VIBRATION ALONE without rotating balls can form pockets in bearing raceway. These surface depressions form far more rapidly when balls actually skid or slide on race surface rather than roll. Metal particles will act as abrasive



CENTRIFUGAL refrigeration systems like this are easy to operate and maintain

CENTRIFUGAL REFRIGERATION LOG

JOB NAME XYZ Company JOB No. 18 MACHINE SIZE No. 0000 SITE 17th & J-G

TIME	COOLED: VACUUM	COOLED: LIQUID TEMPERATURE	COOLED: WATER TEMP. IN	COOLED: WATER TEMP. OUT	COOLED: CHILLED WATER FLOW GPM	CONDENSER: ENTERING PRESSURE—LB	CONDENSER: AIR INDUCTION	CONDENSER: WATER TEMP. IN	CONDENSER: WATER TEMP. OUT	CONDENSING WATER FLOW GPM	COMPRESSOR: SUCTION PRESSURE	COMPRESSOR: DISCHARGE PRESSURE	COMPRESSOR: CONTROLLER CONNECTION POINT	COMPRESSOR: THERMO S-W	COMPRESSOR: ROTOR RPM GEAR RATIO	COMPRESSOR: BEARING TEMP. THRUST END	COMPRESSOR: BEARING TEMP. SEAL END	COMPRESSOR: OIL PRESSURE WATER SEAL	COMPRESSOR: OIL PRESSURE OIL SEAL	PURGE PRESSURE: SUCTION	PURGE PRESSURE: DISCHARGE
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
AM																				
9	—	—	—	—		—		—	—		8	—		—	—	—	—	—	5"	60#
10	13.5	46	60	51		7#		80	89		8	4		4100	110	130	17.5	14	5"	60#
11	15	42	56	48		8#		82	93		8	7		4500	110	132	17	13	—	—
12	15.5	41	56	48		9#		85	95		8	7		4600	112	132	17	13	—	—
PM																				
1	15.5	41	56	48		9#-		84	93		8	7		4500	115	135	17	13	—	—
2	15.5	41	55	47		9#		84	94		8	7		4500	118	135	17	13	—	—
3	15.5	41	57	48		9#+		85	95		8	7		4500	116	136	17	13	5"	60#
4	15.5	41	57	48+		9#+		85	95		8	7		4400	115	135	17	13	5"	60#
5	15	42	57+	49		10#		85	95		8	7		4500	115	135	17	13	—	—
6	14	46	57	50		8#		85	95		8	4		4100	116	135	16	12	—	—

LIQUID LEVEL: STOPPED 2/3 glass; FULL SPEED

MOTOR: FULL LOAD AMPS. 240; TOT. PTS. ON CONTROL 11

MACHINE ROOM TEMP.: 90 °F at 10 AM; 92 °F at 3 PM

DATE 4-1-4; ENGINEER SLM

TYPICAL LOG SHEET for centrifugal refrigeration system has spaces for all important entries. Carefully kept logs like this one make trouble-shooting easier, surer

Don't Baby Centrifugals...

. . . they're rugged, dependable, have few troubles. Just follow these solid tips on refrigeration jobs for easy running. Then when trouble pops up use the 60 time-tested remedies given

By JAMES G MANNING
Manager of Equipment Operation
Carrier Corporation

► CENTRIFUGAL COMPRESSORS are plenty reliable—you don't often have operating troubles with them. But if trouble shows up you want to cure it fast. To do that you must know trouble signs, causes and cures. Table II, *facing page*, gives you dope on operating troubles and what to do about each. Let's see how we can best use it in our everyday work in the plant.

Operation. If you've run reciprocating compressors on refrigeration jobs you know that high head pressure cuts output. Same can be true for centrifugals. Head pressure increase, gradual or sudden, means there's air in condenser if load, speed and other conditions remain the same. Check temperature difference between condenser-water discharge and condenser gas. Increase, with fixed load, may mean air in condenser. Rise of cooler pressure can mean air, too. Run purge unit to remove air from machine.

Other troubles outside condenser cause head-pressure increase. Table shows what they are, how to correct. Moisture removal is as important as removing air. Check machine for tube leaks if you get much water from purge unit each day. The water separates fast when machine is stopped. So if you're getting water, run purge unit awhile after machine stops, before starting.

Typical Controls. Low compressor oil pressure, refrigerant and brine temp automatically shut down machine, as does high condenser pressure. Settings of safety controls for Freon-11 vary, but 6 psi cut out for low oil pressure and 12 psi cut in are usual. Refrigerant-temperature cutout is usually set a few points below design temperature, depending on brine used.

Chilled-water cutout works a few degrees below minimum leaving temperature selected. Condenser-pressure cutout goes out at 15 psi, in at 8 psi for F-11. Only necessary difference in motor and turbine safety controls is in method used to shut down.

Your safety controls should stop machine whenever you have troubles listed above. When this happens look over table for causes, check machine and correct.

Drive. Table lists operating troubles for motors only. That's because turbine troubles can't be generalized too easily. If you have a turbine drive consult instruction book supplied with machine. It lists major troubles and what to do.

Compressor Log. Good log helps spot troubles fast. Fig. 2 shows typical sheet good for most refrigeration jobs using centrifugals. Table I, *facing page*, gives points to check during running and best intervals between checks.

Remember, not all refrigeration jobs are the same. So you may have to change your operating procedure a little to suit the job. Main idea to keep in mind is that you should regularly inspect and care for your compressors during all operations and shutdowns. Don't baby 'em—just treat 'em right.

I: FOR BEST RESULTS RUN YOUR CENTRIFUGAL BY THIS SCHEDULE

COMPRESSOR	
Oil Pressure	Hourly
Bearing temperatures	Hourly
Change oil	Yearly
Pump-chamber oil level	Hourly
Atmospheric float-chamber oil level	Hourly
Replace oil filter	Yearly
Clean oil strainer	Yearly
COOLER	
Clean tubes	When needed
Refrigerant temperature	Hourly
Refrigerant level	Daily
Refrigerant pressure	Hourly
CONDENSER	
Clean tubes	When needed
Refrigerant pressure	Hourly
Safety controls	Six months
PURGE SYSTEM	
Compressor oil	Daily
Motor lubrication	Monthly
Clean condenser	Monthly
Oil level	Hourly
Change oil	Yearly
Relief valve	Daily
Water removal	Daily
Oil separator	Yearly
Compressor valves	Yearly
COUPLINGS	
Lubrication—oil type	Weekly
Lubrication—fluid-lubricant type	Six months
Alignment	Yearly
GEAR	
Oil level	Hourly
Oil pressure	Hourly
Change oil	Yearly
MOTOR	
Oil level	Hourly
Change oil	Yearly
Brushes	Yearly
TURBINE	
Oil pressure	Hourly
Oil level	Hourly
Emergency trip	Daily
SPARE PARTS	
Spares on hand	Yearly

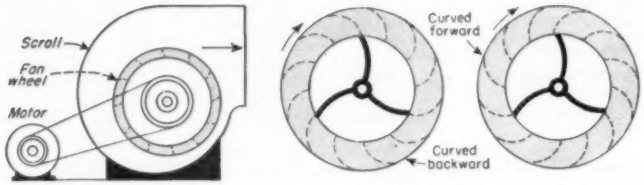
II: USE THIS CHECK CHART TO CURE SYSTEM TROUBLES FASTER

SYMPTOM	POSSIBLE CAUSES OF TROUBLE; CURES
CONDENSER PRESS. HIGH	1 Not enough condenser water 2 Water valves throttled 3 Water pump not running right 4 Clogged strainer or tubes 5 Cooling tower not operating right; fan shut down; sprays or pump clogged 6 Scaled condenser tubes 7 Air in condenser; find and repair leak 8 Condenser float valve stuck closed; adjust float
CONDENSER PRESS. LOW	1 Water inlet temperature low; throttle flow 2 Refrigerant charge too small; add refrigerant if needed
SUCTION DAMPER CONTROL NOT RIGHT	1 Control air off; check air filter and controller 2 Damper links or blades binding; move damper through entire range by hand 3 Controller doesn't operate right; check and adjust
F-11 LEVEL TOO LOW	1 Charge lost or trapped in condenser or economizer by the floats; find leak; check floats; add refrigerant 2 Purge leaking; check relief valve
LOSS OF CAPACITY	1 Condenser not transferring enough heat; see first item in this table 2 Hot-gas bypass valve partly open; close valve 3 Gradual contamination of refrigerant by oil; rectify refrigerant 4 Sudden increase in difference between refrigerant and water temperature; check division plates and gaskets in cooler waterbox for breakage 5 Gradual increase in water and refrigerant temperature; clean cooler tubes, spray deck; remove excess oil from refrigerant, regulate speed to load, check division plates and gaskets
COMPRESSOR SURGES	1 Load too light; open bypass valve 2 Air leak; run purge and repair leak 3 High condenser pressure; see first item in this table
COMPRESSOR SHUTS DOWN	1 High condensing pressure; check water quantity, condenser float valve; purge air 2 Low oil pressure; check strainer cleanliness and reducing-valve setting 3 Low refrigerant or chilled-water temperature; check refrigerant level, chilled-water flow; regulate load
COMPRESSOR 2ND STAGE FROSTS	1 Economizer float valve blocked; check float operation 2 Light load with high compressor speed, cold condenser water; increase condenser pressure, reduce speed 3 Suction-damper closure causes circulation of condensate from economizer
THRUST END OVERHEATS	1 Bearing worn from lack of lubrication; replace 2 Excess pressure from gear or couplings; check for mechanical interferences
HIGH OR LOW OIL PRESSURE	1 Too much oil dilution of refrigerant or foaming on start; pump out by starting compressor momentarily several times; remove diluted oil and replace 2 Oil pressurestat out of adjustment; check setting, re-adjust 3 Compressor speed too low (turbine)
COMPRESSOR BEARING TEMPERATURE HIGH	1 Not enough cooling water flowing through oil cooler; open throttling cock to oil cooler 2 Too much oil dilution of refrigerant on starting or electric oil heater off during shutdown 3 Pump-chamber temperature above 150 F on start; turn on cooling water earlier during start; check for clogged cooling coil 4 Thrust or shaft bearing scored; check bearing and shaft-end clearance
COMPRESSOR LOSES OIL	1 Worn labyrinths; check rotor balance and bearing wear 2 Oil system leaks; check oil piping and correct 3 Oil level too high; drain oil
PURGE UNIT DOESN'T RUN RIGHT	1 Motor thermal overload burned out; replace 2 High-pressure cutout-switch contacts open; check setting and operation; reset if needed 3 Air-cooled condenser fouled with lint and dirt; clean with compressed air 4 Shutoff valves closed 5 No power; check switch, contacts and connections 6 Broken belt; replace 7 Separator float valve stuck; valve off unit, evaporate F-11, open tank and fix float 8 Air relief valve stuck; stop purge unit, remove valve and repair or replace 9 Suction-line reducing valve stuck; valve off purge unit at condenser, remove valve and repair or replace
COMPRESSOR COUPLINGS NOISY	1 Misalignment; check at operating temp; realign 2 Not enough lubrication; add oil or grease 3 Excessive wear; replace
DRIVE MOTOR OVERLOADED	1 High chilled-water temperature or flow; regulate 2 Damper open; regulate as needed 3 Refrigerant level too high; remove refrigerant
GEAR OVERHEATS	1 Oil level too high; drain oil 2 Fouled cooler; clean 3 Not enough cooling water; increase flow 4 Misaligned coupling; check

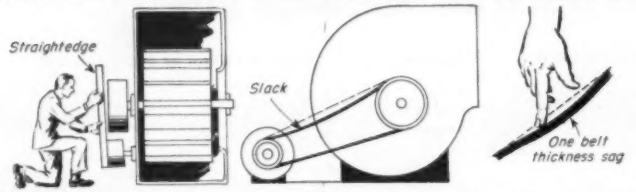
Maintenance HINTS

Here are 3 money saving ideas that have cut down outage. Better put them to work now.

FAN TIPS... Are your fans working as they should for summer load?

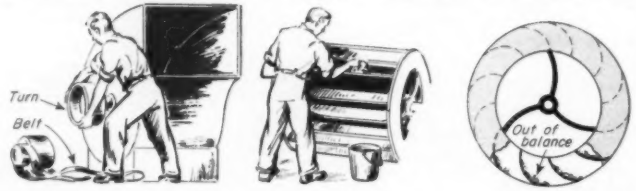


ROTATION — curved forward and curved backward type both run in same direction



ALIGNMENT of pulley, and belt slip are checked at regular scheduled times in season

LUBRICATION is often taken for granted. But it's most important maintenance job



BALANCING is quick and easy. If not done, unbalance can wreck costly bearings

FIRST MAKE SURE fans are rotating in the right direction. Does that sound silly? I've been designing and installing air-conditioning systems for some time and it's surprising how often fans are put in wrong.

Every air-conditioning man has run across fans that were rotating in the wrong direction. Check rotation even if fans have been in a long time.

PULLEY ALIGNMENT is next. Hold a straightedge against pulley sides as shown here. It's usually easy to move motor slightly to align pulleys, then belts last longer. If there's belt slip, check for slack by pushing one finger against belt. For most belt lengths used on fans, sag should be about one belt thickness as shown.

LUBRICATE the motor and fan bearings at regular intervals. Whether ball, roller or babbitt bearings, follow the manufacturer's advice. If you don't have literature, send for it. A burned-out bearing causes more expense than scheduled lubrication. Too often this important operation is slighted because the fan seems to run okay.

CHECK FOR BINDING before each season. Remove belt and turn fan by hand a few times. Before making this check, clean the fan blades thoroughly with Stoddard's solution, Jan *OE*, p 36. Accumulations of dirt often cause unbalance and set up excessive vibrations at high speeds. Then bearings fail in short time. Don't neglect fans!

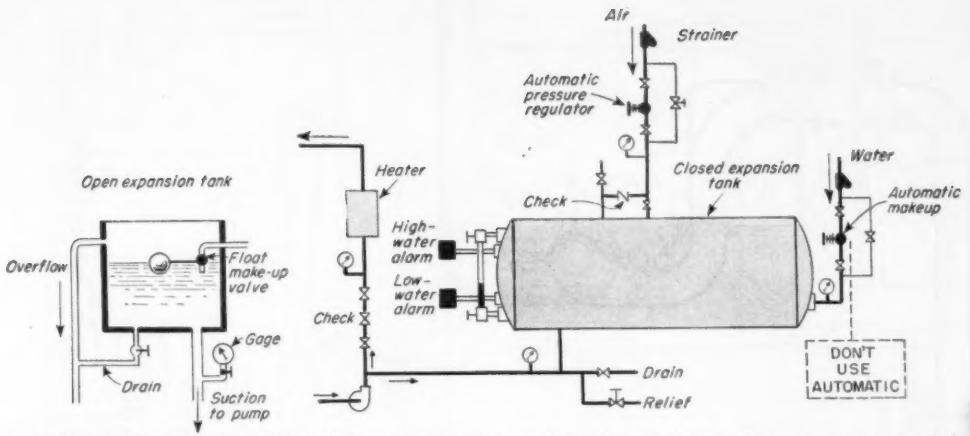
J H Braverman *Staten Island, N. Y.*

LEAK DETECTING... How do you know when there are leaks in heating system?

► We lost a lot of hot water from our heating system before we knew it had a bad leak. And it took the first cold day of winter to let us know something was radically wrong.

After much running around, we found a broken pipe to the engine-room radiator. Because it was imbedded in concrete, this leak had been wasting water for some time, undiscovered. Luckily, both lines to this radiator were valved, so we cut it out. And after that experience, we worked out a scheme to prevent further leaks going unnoticed. But first, let's talk about expansion tanks.

Expansion Tanks. A hot-water heating system needs an expansion tank. The expansion tank is connected to supply makeup water for that lost by evaporation and gland leakage. Tank also maintains a positive head on suction of centrifugal circulating pump. This prevents pump from becoming vapor bound, which is common without this hookup.



OPEN AND CLOSED expansion tanks in heating systems can be used to advantage in uncovering your costly water leaks

Twenty-five cu ft of water at 40 F expand to about 26 cu ft at 200 F. So the tank also provides for this change in volume, as water heats up. That prevents rupture in the system. Without a tank, excessive pressure is dangerous.

Open Tank. Expansion tanks are either open or closed types. The open tank is open to atmosphere, and located above the highest radiator. It furnishes three requisites by means of a float makeup valve, its elevation and by an overflow line, see above sketch.

Closed Tank. The closed tank can be placed at a low elevation, sometimes even at pump level. It's filled partly with water and partly with air. Then as water expands, volume of air in closed tank is compressed without producing undue pressures in the system. A closed system also enables higher temperatures without danger of boiling.

Bad Leak. Our system is a closed system with tank equipped as shown in sketch. The pressure is automatically maintained at 25 psi. *And automatic makeup was the trouble.*

The radiator line continued to leak and the regulating valve continued to furnish makeup. So no one looked for a leak. The water kept running out of the concrete until that cold day. Then we had to find where all our heat was going. We tried various things, then finally got around to listening to and feeling the water line to the expansion tank. That told the story.

To detect leaks in this large system quickly in future, we stopped using automatic feed. Now we depend only on high- and low-water alarms and sight glass. Time spent on hand control is well spent. Overfeeding shows up in water leak. High water with no pressure increase means an air leak at tank. High water is okay if water gets hotter because level rises due to expansion.

F J Ardolino *Brooklyn, N. Y.*

Editor's Note: Let's have arguments on Ardolino's solution.

FRESH AIR... Don't forget human repair bills. Employees are important too

► While thinking about preventive maintenance, don't forget to make improvements to cut down repairs on employees (doctor bills).

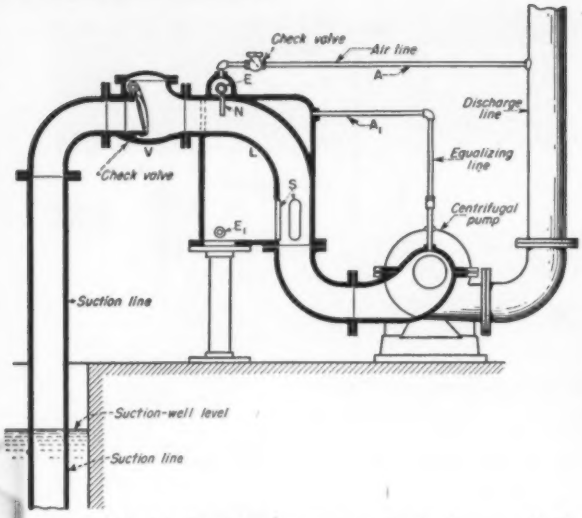
The air in the U S Metals Refining Co's smelter at Carteret, N. J., contains certain vapors at a high temperature.

The air-conditioning unit shown keeps cool, steady temperatures inside cab. And the activated carbon "air recovery" above prevents harmful smelter fumes from entering operator's cab. Door is open here, with dust filter removed to show carbon-filled canisters which soak up these gases.

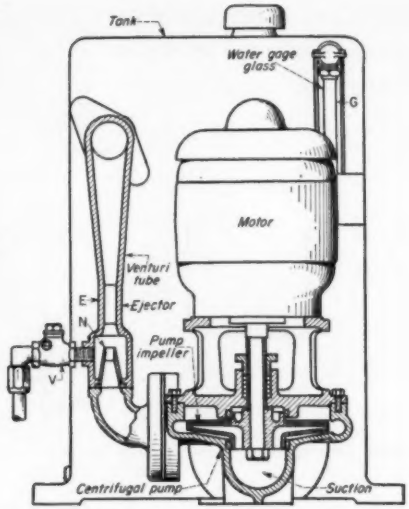
While working on air-conditioning systems, be sure to install canisters where there are odors or fumes.

Dick Orr *New York City*

ACTIVATED CARBON keeps conditioned air for operator free from harmful fumes



1 Elevated tank in the suction line permits a centrifugal pump to operate as part of a wet-vacuum-pump priming system



2 Vacuum-pump system includes a vertical centrifugal pump that supplies water to an ejector for priming operations

Vacuum Pumps Prime 'Em

Here's how to use vacuum pumps to prime centrifugal types and keep them primed when the fluid contains air or gas. If you have a pump-priming problem maybe you'll find the answer here

► VACUUM PUMPS are used extensively to prime centrifugal types, either by manual or automatic control. These priming pumps may be dry or wet vacuum and rotating or reciprocating types.

Priming Tank. Fig. 1 shows a centrifugal pump with a priming tank in its suction line that serves as a wet vacuum pump. The tank is placed in the suction line above the pump and has a check valve *V* at its entrance.

A long radius elbow *L* in the tank connects to the pump's suction. Large slots *S* at the lower end of the elbow connect to the priming tank. Electrodes *E* and E_1 in the tank start and stop the centrifugal pump during priming.

An air line *A* connects from the high point of the tank into the discharge line. An equalizing line A_1 connects the pump suction into the priming tank.

Starting the Pump. Assume the pump taking water from a sump that fills and closes the sump switch. The priming tank is full so water contacts top electrode *E* and closes a relay that starts the pump through the float switch. The pump draws the water from the tank and pushes it into the discharge line.

As the water level falls in the tank it creates a vacuum to draw air through the check valve from the suction line. When water in the tank drops below the lower electrode E_1 the pump stops. Water in the discharge line then flows back through the pump to the tank.

As the water level rises in the tank it acts as the piston of an air pump to force air from the tank through line *A* into the discharge line. When the air has been expelled, water contacts electrode *E* and the cycle is repeated until the pump is primed. It then continues to run until stopped by the float-switch opening.

Ejector Vacuum Pump. Fig. 2 and 3 are part of an automatic primer that consists of a vacuum pump and a float-chamber mechanism that controls the pump. The vacuum pump combines a vertical motor-driven centrifugal that discharges through the water ejector *E*.

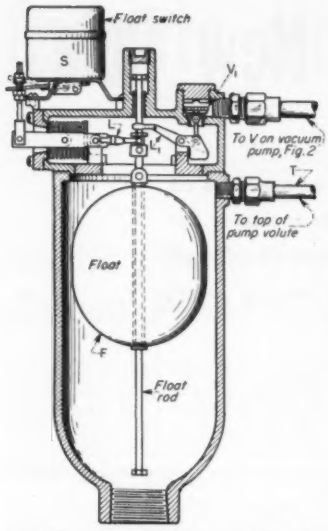
Pump and ejector are mounted on the side of a tank. The latter stores water for the pump and ejector and serves as an air-separating tank.

Water gage glass *G* shows water level in the tank. Check valve *V* between the ejector and centrifugal pump keeps air from leaking into the pump when the ejector is not in use.

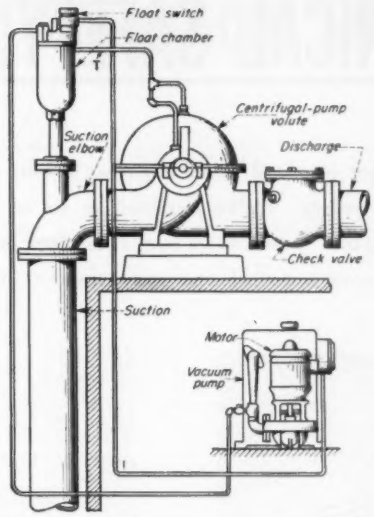
Float Chamber. This chamber, Fig. 3, has a copper float *F*, free to move vertically on a float rod. Switch *S*, opened and closed by the float, controls the pump motor. The float chamber connects to the pump's suction elbow, which also acts as its support, Fig. 4. Tap *T* on the float chamber connects into the suction eye and the volute's top as shown. A connection above, check valve V_1 goes to check valve *V* on the ejector, Fig. 3.

When the float drops to the bottom of the chamber it moves the rod down and in doing so closes switch *S* through lever *L*. The vacuum pump starts, takes water from the tank bottom and forces it through the ejector to the tank's top.

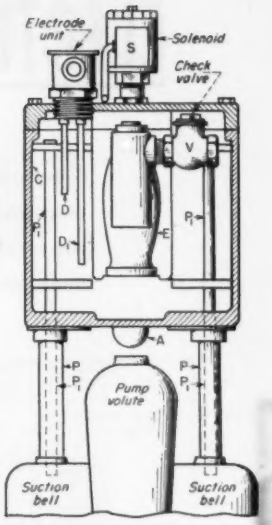
Water passing at high velocity from nozzle *N* into the venturi tube, Fig. 2, draws air from the main pump casing and the suction line. As air is exhausted, water rises in the suction line and pump casing. But the vacuum pump



3 Float chamber has a copper float on a rod that controls a vacuum-pump



4 Automatic primer on this pump includes a vacuum pump and a control



5 This automatic priming system has a chamber mounted above the pump

By B A BRIGGS, *New York, N. Y.*

continues to operate until water rises in the float chamber and the float lifts levers L and L_1.

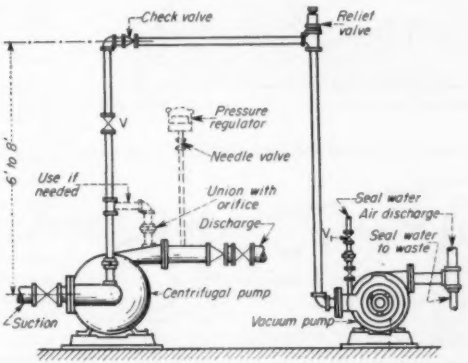
Moving lever L up opens switch S to stop the vacuum pump, and L_1 closes stop valve V_1. The latter is held closed by weight W to isolate the float chamber from the ejector. The centrifugal pump is now primed and can be started.

Submerged Suction. Fig. 5 shows a simple submerged-suction priming system to keep a pump primed. It has a priming chamber C supported on and above the pump's casing by two pairs of pipes, one pipe inside the other. The outside pipe P connects to the bottom of priming chamber C, while the inner one P_1 rises nearly to the top of chamber C and extends into the pump's suction bell.

In the chamber an ejector E draws air from the priming chamber through check valve V. A solenoid-operated valve S controls pressure water to the ejector. Two insulated electrodes D and D_1 connect to an induction relay.

Solenoid Valve. When the priming system is energized the solenoid valve opens. Air is drawn from the priming chamber, pump casing and suction line. As the air is exhausted water rises in the suction line, the pump casing and into the priming chamber through the outside and inside pipes P and P_1.

When water rises in chamber C to electrode D the solenoid circuit is opened and a spring closes the valve in the pressure-water line to the ejector. The main pump motor is now started manually or by automatic control.



6 Manual system for priming with a vacuum pump. After priming is done vacuum pump is shut down and valves closed

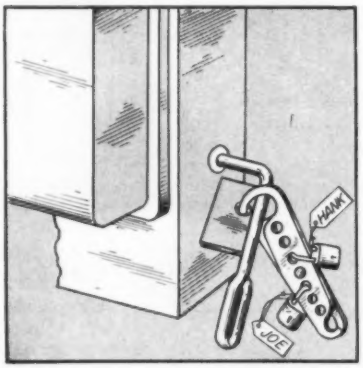
Rotary Vacuum Pumps. Vacuum pumps are used in many ways for priming centrifugal pumps, either by manual or automatic control. Fig. 6 shows one arrangement for priming centrifugal pumps with a rotary vacuum pump. The full-line layout is for manual control when starting and stopping the primer.

When the centrifugal pump is to be primed, the vacuum pump is started. After priming, the vacuum pump is shut down and the valves V and V_1 are closed in air and water-seal lines. Where the vacuum pump has to operate all the time to keep the centrifugal pump primed, valve V may be omitted.

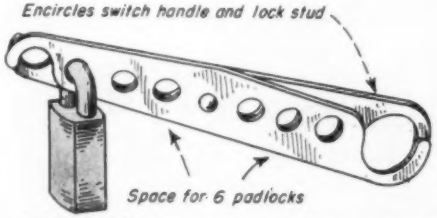
Pressure Regulator. For automatic operation of the primer a pressure regulator is connected in the discharge, as indicated by dotted lines. This regulator starts the vacuum pump if main pump loses its prime and stops the priming pump when priming is completed.

ELECTRICAL SAFETY: New Rules,

Every plant man and safety engineer has his own pet ideas on electrical safety. We've rounded up six of them (ideas, not the men!) and spread them over these four pages. They've all been proved practical and may save a life in your plant



SAFETY SWITCH often has room for but one lock. With this . . .



. . . **MULTILOCK RIG** all men involved can snap on their padlocks

Locking That Electric Switch

Big reason for locking a switch in the open position when working on a machine is to prevent personal injury. Maintenance workers in particular run into these hazards. Perhaps it's because each maintenance job generally differs from every other job.

Sure, it's important that every plant establish a basic uniform safety policy. But this plan should include a clear understanding on how to lock switches where a lad is working on the machine. Then broaden this by outlining how to avoid confusion when two or more departments are involved.

One Solution. Here's what one industrial plant does: When maintenance and production men must work on a piece of equipment it's the electrician or maintenance man who removes the fuses. Then the production man who plans to enter the equipment itself will personally lock the switch. On top of that the foreman must check both safety measures before giving final clearance to the production man to do his part of the job.

Several methods have been used in the past to protect worker and equipment: posting warning signs, removing fuses, using "hold-off" tags, etc. But none of these provides positive protection. Removal of fuses is not foolproof unless a qualified electrician opens circuit switch before they are removed. Switch must be locked and tagged in the open position. If not, some fellow is sure to amble along and stick in a set of spare fuses. Then there's always the hazard of an unauthorized man removing the wrong fuses or getting a burn after pulling the fuses under load.

Cold facts show that the only positive way to protect men from machine accidents is to lock the main machine controls in "off" position. Some equipment is now manufactured with flush or bolted-on locks that are approved by the Underwriters Laboratories. But where these locks are not installed individual locks should be used. Then each man is responsible for placing and removing his own. And even this method fails if not used in accordance with a strict safety policy.

Padlocks. Each man must use either a combination lock or tamperproof padlock. Locks may be painted various colors to simplify identification. Color indicates types of crafts working, or on what shift. Each lock should carry the employe's name, either stamped on direct, or on a metal tag attached to the lock.

Issue only one key to each man. Foreman should keep an extra key in his office. He should never lend his key even though the workman's key seems lost beyond recovery. In an emergency the foreman should use the extra key himself. Then destroy the old lock and extra key. Replace with a new lock. On some locks, tumblers can be changed by a locksmith and fitted with two new keys.

Where combination locks are used, only the supervisor should have an extra copy of combination. Each lock, whether a padlock or combination, must be different from every other lock used by the maintenance department. Where two or more men are working on the same job, each man should attach his own lock. In that way the controls cannot be operated until all locks are removed. Each man should realize that even if someone has already locked the controls, he is still not protected unless he attaches his own lock.

You'll meet many switches that will accommodate only one lock. In such cases make a lock-rig from ⅛-in. metal, as shown to left. This will hold several locks at a time.

NATIONAL SAFETY COUNCIL *Chicago 11, Ill.*

Gadgets and Common Sense!

Static Electricity Can Cause Plant Fires

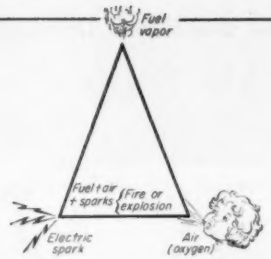
When two unlike materials make contact they become electrified. One is charged with positive electricity, the other with negative. And if one is an electrical insulator, each substance holds its charge when they are separated. This shows up as a voltage difference. Resulting spark plus fuel and oxygen means fire.

Many fellows overlook the static-electricity angle when planning for storage and handling of flammable liquids (those with high resistance and low flash point). All such equipment should be thoroughly bonded and grounded. Piping for distributing these liquids should be electrically bonded together and to the tanks they connect with. Connect bonds around all pipe joints insulated by packing material or gaskets.

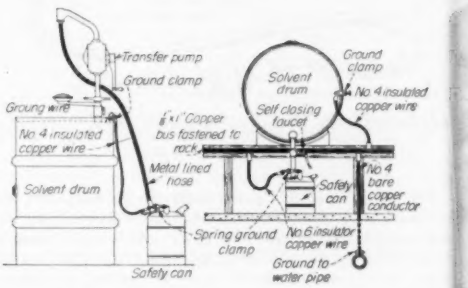
You're running a chance every time you pour hazardous liquids (gasoline, benzol, etc) unless the metal containers are thoroughly bonded and grounded together. Hose should be metal or fitted with metal lining or ground wire.

At loading and unloading stations for tank cars, the track should be grounded and bonded to filling pipe. Then run temporary ground wire between filling pipe and car.

ASSOCIATED FACTORY MUTUAL FIRE INSURANCE CO, *Boston*



FUEL, OXYGEN, SPARK are all you need for fire or explosion



END STATIC HAZARD by grounding containers carrying solvents

Padlocks Are Safety Tools But...

It's not wise to depend on any "safety-practice" that requires perfect cooperation of several men to insure against accidents. And signs give only one step toward the desired results. Padlocks go much farther . . . but the final and most important safety measures rest with the man himself.

Signs. Some years back a motor-driven 50-hp fan burned out a bearing. It had to be replaced in a hurry. Maintenance foreman placed signs on control apparatus so they were easily read 100 ft away. Bearing failed near end of first shift; second shift came in while maintenance crew had motor apart. Then out of a clear sky the second-shift man, who ordinarily maintained the fan, went over to the control box on the wall near an open window. He was a 10-year veteran. He was distracted for a moment, but instinctively reached along the wall and threw in the 2-step motor controller without looking at it.

There was plenty of damage. The second-shift operator was fired, and maintenance foreman was bawled out for not pulling all fuses.

Locks. Another case involved a heavy sand-mixer in a modern mechanized foundry. This machine was gear driven from a 100-hp motor. It had a mixing bowl six feet in diameter by three deep. Heavy blades turned at 100 rpm to mix the sand. Because blade maintenance was high, the safety department laid out a procedure that seemed hard to beat. Only access door to the bowl was kept locked with a heavy padlock. This lock resembled one on the disconnect switch, which was down a flight of stairs from the pushbutton control station on the operating floor. Here was the procedure for a maintenance man to follow when working on the mixing blades: First, he went to the disconnect switch. When this lock was open the key could not be removed from the lock. Movable part of switch had a hole in it, which lined up with one in a stationary part when switch was in full-open position. Padlock was supposed to be pushed through the switch holes, then locked with the key. The key could then, and only then, be released and used to open the bowl door. Repair man was supposed to put the only key in his pocket and hold it till work was completed. But even this system failed because of "a human failure."

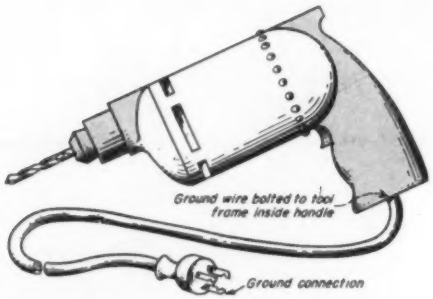
Human Failure. At lunch hour, when the mixer was deserted, the repair man came for a quick "look-see" at the mixer blades. He pulled out the disconnect, but instead of locking the switch open, merely locked the padlock and left it hanging on its chain. He then took the key and went into the bowl with its powerful blades. The machine operator was behind schedule, so he came back after a quick lunch and tried to start the motor in the regular way. When it did not start he went downstairs to the disconnect switch and found it open but unlocked. He slammed it in, went back upstairs to

the pushbutton control station and started the motor with the repair man inside the mixing bowl. Before the unit could be stopped, the lad was so badly injured he died a few minutes after removal.

The only improvement on this machine so far has been a positive interlocking device that locks as the switch is opened. Then, and only then, can the bowl-door key be released.

H B Mc DERMID *Norwood, Ohio*

Avoid Low-Voltage Shock by Grounding Portable Tools



POLARIZED PLUG, if pushed in receptacle, grounds portable tool

Low-voltage portable power tools can be dangerous from the shock angle alone. Of course, as long as the tool's electrical insulation holds up there's no shock problem. But when she breaks down to the tool frame, you've got 120 v between your hands and ground. Hence the need for grounding frames of portable tools. One method was shown on p 46, Sep 1950, OE.

Best way to ground portable equipment is through a 3-prong plug and receptacle. Third prong in the receptacle connects to the conduit that is permanently grounded at the service entrance. The male appliance plug should be the 3-prong variety. Two of the prongs carry the normal power to the tool, while third is ground lead.

At tool end of rubber-covered electric cord, this third wire connects to frame of portable machine. Then every time the plug is slipped into the receptacle, the tool frame is automatically grounded.

Sure, we know a standard 2-wire plug can be used, leaving the third wire hanging hopefully by its side. But then you're depending on the tool operator to attach the ground wire each time the tool is used. Take a walk around the shop, and notice how many of these ground leads are now in use!

I've read recently, I believe, in the *Westinghouse Maintenance News*, an item on actual cost of replacing standard wall receptacles with the 3-wire type. This work was done in a plant some years back and cost $1.85 for each converted wall receptacle. Cost to change the plugs and cables on each portable tool averaged out to a little less than $3 each. But these costs were far outweighed by the improved safety to the men.

JIM SPARKS *Toronto, Canada*

Sweat and Electric Shock

USE DRY STICK on all live circuits *especially if you're sweating*

If you ever get a "belt" off the plant electrical bus, let's hope it's a dry day in winter. Sweat increases the electrical hazard by making the body a better electrical conductor. Some fellows try to get around this additional summertime worry by having all the electrical crew cut their water intake during the hot months. Sure, they'll sweat less, but then they're subject to heat stroke. You must replace body liquids. So when sweating be extra careful around electricity.

Heavy sweating takes salt out of the body along with water. Salt tablets will cover this angle. Or you can add the salt directly to the drinking water. Try one teaspoonful of table salt to every gallon of water. But getting water back into the system is more important than replacing the salt lost. Blood pressure drops when body's water content is below normal. This results in a drowsy feeling, which may cause accidents.

Cold tea is a good thirst-quencher but avoid alcoholic drinks during the day. They produce more heat within the body.

Worst time is between 2 and 5 in the afternoon. This rings in the heat peak of the day and follows the noonday meal. Second greatest number of heat accidents occur between 7 and 10 pm. Reason is that indoor plant temperatures will stay up even though the outdoor temperature is dropping.

W SCHWEISHEIMER, MD *Rye, New York*

How Electricity Affects The Human Body

SLIGHT GROUND may tickle, but it can throw lads off scaffold

Man-made electricity killed its first victim in 1879. Today in the United States and Canada, electricity kills seven per million population each year. About half the reported electric-shock accidents are fatal.

Here are main points when considering effect of body shock: (1) circuit voltage and frequency, (2) body resistance between points of contact (3) current path.

Deaths have occurred on commercial frequency circuits at voltages as low as 46 v. It is generally considered that voltages in the order of 24 and below are safe. This may be true from a purely electrical standpoint, but they may cause accidents because of involuntary muscular contraction.

Body Resistance. The outer layer of skin (the graybeards call this epidermis) is the body's best layer of protection against electric flow. When this outer skin is dry, its resistance is relatively high. For instance, the calloused palm of a lad in your plant will measure about 15,000 ohms per sq in. But when this outer skin is soaked, either with water or sweat, its resistance may drop to below 150 ohms. Once the current sneaks by the outer skin (epidermis) there is but little bodily resistance to the flow of electric current.

In addition to changing its resistivity when wet, skin resistance will increase during sleeping and it is high in sections of the body that are paralyzed.

On top of that, bodily resistance varies with applied voltage. For example, measuring body resistance from hand to hand, using 60-cycle ac source, gives the following values: 10,000 ohms at 50 v, 1200 ohms at 500 v, and 1000 ohms at 1000 v.

Low voltage brings up the blister hazard. When blisters form, the outer skin loses its protective high resistance. And heat resulting from contact with a 120-v circuit will form blisters within a few seconds.

Because of the marked lowering of skin resistance by moisture take extra precaution when sending men out to work with electric tools in damp locations (read what Dr Schweisheimer says about electrical hazards because of sweat . . . the doc's story is right before this piece).

Ohm's Law Holds! Value of current flow through body is determined by our old friend, Ohm's Law. This means that current in amperes equals applied voltage divided by resistance of circuit in ohms. Remember, it is the quantity of electric current flowing through the body that determines to a large extent the resultant injury.

And path the current takes in the body is important. In general, if there are no vital organs in the way, resulting injury is usually confined to burns.

One milliampere of 60-cycle ac generally produces a tingling sensation at point of contact. Of course, this precise value varies with individuals and with frequency. This minimum "tingling" current holds to 300 cps. The tingling decreases as frequency climbs. At 100,000 cps there's more heat than tingling sensation. These minor current sensations are not in themselves dangerous. But they can readily be a direct cause of a serious accident. For instance, the fellow who receives a minor electric shock then falls off a ladder because he jerks away from the circuit.

Let-Go Current. When current flows through the body, muscles in its path contract. This contraction may be so severe the victim cannot release his grasp on the live line.

We define the *let-go current* as that value a man can stand without harmful effects. At least, for the time required to release his hold on the circuit. At commercial frequency (60 cps) the let-go current is 9 milliamperes for men.

Freezing Current. Using a similar yardstick, we define *freezing current* as the value that will contract the muscles to the point where the victim cannot let go the circuit (about 20 ma). Of course, the freezing current is naturally greater than the let-go. This freezing current is mighty important since it requires only a few seconds for blisters to form. These blisters are generally in that portion of the body in path of current. When they form, the epidermis loses its protective resistance and current increases in accordance with Ohm's law. And if someone isn't around to release the poor fellow from the circuit, the result could easily be fatal.

Maximum current that any man can tolerate for a short period without losing consciousness lies somewhere between the freezing current and the current that would stun the heart (ventricular fibrillation). This maximum current lies anywhere between the freezing current of 15 to 25 ma, and the fibrillating current of 75 to 100 ma.

Ac or Dc? To answer this time-honored question, as to which causes most serious shock—ac or dc—let us first review two fundamental facts. Muscles contract when contact is made with an electric circuit. This contraction of the muscles is more severe on commercial frequency circuits than on dc. Where exceptionally good contact is made, or where high voltage is involved, the victim may be thrown clear of the circuit. Therefore, dc has less of a shocking effect on the human body because of (1) bodily reaction and (2) the usual low voltages involved.

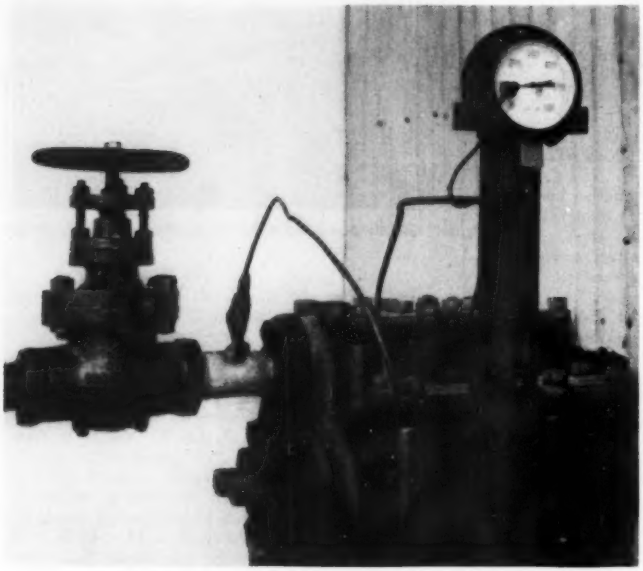
Electric Burns. Often burns are the direct effect of an electric shock. These are generally of two types: (1) Heat burns, which result from the electric arc. These are generally formed at the point of contact. (2) A straight electric burning of the tissue through which the current passes.

The true electric burn forms a pinkish spot on the skin's surface. Many such burns, however, may penetrate deeply and take a long time to heal. Burns or blisters may not even be present on the skin after an electrical accident. Unless the skin is soaked with water and the contact area is large, a fatal shock may not leave the slightest blemish.

The electric-shock victim may lose consciousness. In some instances he may recover immediately and in others only after the application of artificial respiration. There are cases on record where men have been knocked unconscious from contact with a circuit, at two points on the same leg or arm, when there was no burning of the tissues. In such cases no current passed through any of the vital organs. It is generally agreed that unconsciousness was caused by severe shock to the system.

NATIONAL SAFETY COUNCIL *Chicago 11, Ill.*

PRACTICAL IDEAS... *here's the trading post for your*



PRESSURE GAGE STOPS ENGINE

A GAS-ENGINE-DRIVEN reciprocating pump had to operate unattended for several hours at a time. Changes in the system into which the pump discharged might cause too high pressure. To guard against this a pressure gage was used to shut down engine, as shown in the photo.

Opposite the limit of pressure on the gage the engineer drilled a hole in the glass front. With two nuts he locked a ⅛-in. bolt in the hole so it would just clear the dial. A wire connected this bolt to the low-tension circuit on the magneto. When the gage pointer touches the bolt it grounds out the magneto and the engine shuts down.

This device is also used to shut down an engine when pumping from tanks. In this case the bolt is put in the glass front of the gage at a pressure lower than normal. The pointer is above the pin and a switch is used to open the protective circuit until the pump is started and is up to pressure. This device automatically shuts the pump down when the tank is nearly empty and prevents air being pumped into the discharge line.

HARRY A HESS *Houston, Texas*

Turbine Generator for Synchronous Condenser

USING AN IDLE ac generator to correct power factor is not new, but some industrial plants may not know how this is done. In one plant two 2000-kw, 0.80-pf generators supplied a load of 6000 kva. Because of its low water rate, an old 1000-kw unit was not used except in emergencies.

To reduce the load on the large units to a safe limit the old generator was used as a synchronous condenser. It was brought up to speed and connected to the bus in the usual way. The governor was adjusted so that the machine took very little load. Then, the generator field coils were over excited until the power factor on the other units was about unity. This brought the load within rating of the larger machines.

No change was made in the 1000-kw unit. Therefore, it was always ready to pick up load in an emergency. While in operation, the steam valve is partly closed so that just enough steam goes through the turbine to keep its blades from overheating because of windage.

By controlling the field current of the old generator, power factor of the station load can be corrected to any desired value, so long as safe operating temperature of the field coils is not exceeded.

Where the old generator is not needed for standby use, it may be cheaper to scrap it and install a modern synchronous condenser. But it is not always easy to get management to scrap an old machine and buy a new one.

R C HENDERSON *Chicago, Ill.*

Fastening Holding-Down Bolts in Concrete

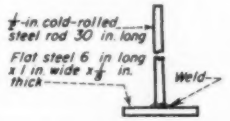
MOLTEN LEAD is often used around holding-down bolts to secure them in drilled holes in concrete or brick. We find that molten sulphur poured around such bolts holds them more securely than lead. Lead has a tendency to flow under stress, where sulphur does not.

Sulphur fumes are unpleasant and in close places may be dangerous. So be sure you have plenty of ventilation when heating and pouring the sulphur or conditions may become extremely uncomfortable.

M N GOZDENOVICH *Fairview, N. J.*

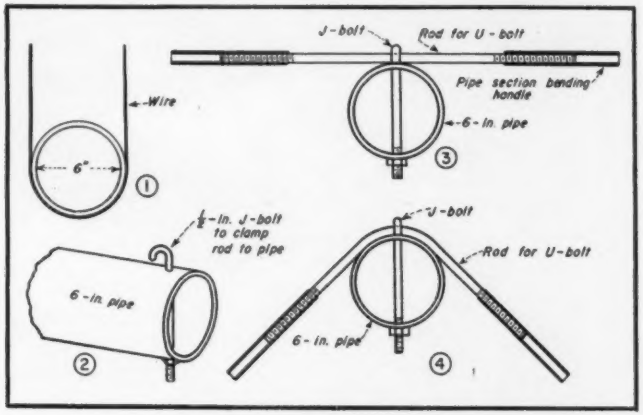
Electric Drill Drives Fire-Clay Mixer

MIXING FIRE CLAY by hand for brick laying, used to be a tough job for us. We mixed it in a 55-gal drum with one head cut out. In this drum, we mixed three 100-lb bags of fire clay with 50 gal of water and stirred it by hand with a paddle. This required 30 to 35 min of tough going, so I got lazy and looked for an easier way.



I made a mixer from a 30-in. section of ½-in. cold-rolled steel rod. To one end I welded a 6-in. bar of 1-in. x ⅛-in. flat stock as in the drawing. The other end of the rod we put in a heavy electric-drill chuck. Into the drum of fire clay and water we put the paddle and turned on the power. In five minutes, mixing was completed. Just what we wanted.

R H CARTER *Uxbridge, Mass.*



HOW TO BEND U BOLTS

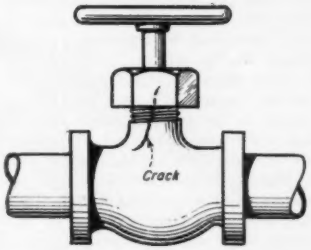
IN EVERY engineer's life there comes a time when he has to make a lot of U-bolts to support pipe or other equipment. The old way has been to make the bolt longer than necessary, then cut the ends to correct length after bending.

To get the length of the rods for the U-bolts we bent a piece of wire around the pipe and cut the wire to suit Fig. 1. We then straightened the wire, cut the rods to this length and threaded their ends.

To bend the rods we drilled a hole through a piece of pipe of the correct size and put in a J bolt, Fig. 2. We clamped this pipe section in a pipe vise and marked the center of the rods. To bend a rod, we put its center mark under the J and clamped it in place, Fig. 3.

Pipe sections are placed over the rod's ends to do the bending. The center section of the rod is heated with an acetylene torch before bending, Fig. 4. A little care in the heating and bending operations will produce U's of the correct shape.

G G AVANT *Wilmington, N. C.*



Welding Repairs Cracked Ammonia Discharge Valve

WHEN TIGHTENING the packing nut on an ammonia-compressor discharge valve I heard a crack. Ammonia gas began to leak so I opened the windows then started two small units and shut down the large one. After removing it from the line we scraped the old paint off the valve and found it cracked as in the drawing. A new valve was not readily available, so we took the old one to the welding shop. There we v-grooved the crack and welded it.

We removed excess welding metal with a grinding wheel and by draw filing. Welding had to be carried up into the threads, so they had to be recut. This we did with a three-cornered file and made them match the undamaged sections so the packing nut screwed on with normal effort.

N GOZDENOVICH *Fairview, N. J.*

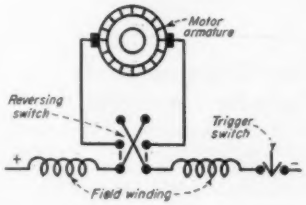
Foot Wipers Keep Engine Room Floor Clean

LIKE GOOD housekeepers, many plant engineers insist that your shoes be clean before entering. In overhauling diesel engines, dirt lies around a plant. During these periods in one plant the chief engineer puts jackets over the rubber mats used for normal foot cleaning.

These jackets are made of feed sacks washed and turned inside out. Putting the rubber mats inside the sacks holds the latter so that shoes can be scrubbed clean of oil.

When the sacks become dirty they can be taken off and replaced by clean ones. The sacks are cleaned in the plant rag-reclaiming machine, and serve during the overhaul season.

ELTON STERRETT *Houston, Texas*



Reversing Switch Speeds Electric-Tool Operation

A TWO-POLE double-throw reversing switch can be used to speed up electric-tool operation. We have one on our wire-brush that does a good job.

We found that after driving the brush in one direction for a period the wires started to lean backward. This caused them to lose their scratching power. Throwing the reversing switch to its opposite position corrected this trouble. When brush rotation reverses the wires soon stand erect and cut as well as ever.

The diagram shows how the switch is connected in the armature circuit. Armature wires are brought to the reversing switch through one of the ventilating holes in the motor's end bells. As the reversing switch has no off position the trigger switch starts and stops the motor.

We used a similar scheme on an electric drill driving a ⅜-in. tap. We tapped about 300 holes in vertical angle irons out in the plant without breaking a tap. The job was done in less than a day.

To do this we ground two sets of taps for this work. One set we ground from zero thread at their tips to one-

half thread at their bases. We first threaded the holes with a half-thread tap, then with a full thread one. In both operations the taps were run full length into the holes.

After about the first dozen holes, we became experts at timing the trigger switch on the drill. We could stop the tap at about the last thread. Then throw the reverse switch and back out the tap.

Manufacturers of wire brushes do not advise using a reversing switch. They say the brush may unscrew off the motor. But our sheet-metal workers have had no such trouble in over eight years, use of the reversing switch.

H H Bryan *Montreal, Que.*

Screen and Gloves Break up Chemicals

We had trouble with our boiler-water chemical-feed soda-ash tanks. Soda-ash absorbed moisture from the atmosphere and formed large solid pieces in the bags. When dumped in water the lumps formed a hard coral-like mass before dissolving.

When tanks have an agitator the lumps may damage the paddles. A paddle, funnel or funnel cover may break before the drive motor can be shut down.

After this happened a few times we placed a 1-in. mesh screen over the charging opening. We now pour a 100-lb bag of soda-ash on the screen. Then with gloved hands we work the fines and lumps through the screen. Since doing this we have had no paddle trouble.

C J Troske *Bay City, Mich.*

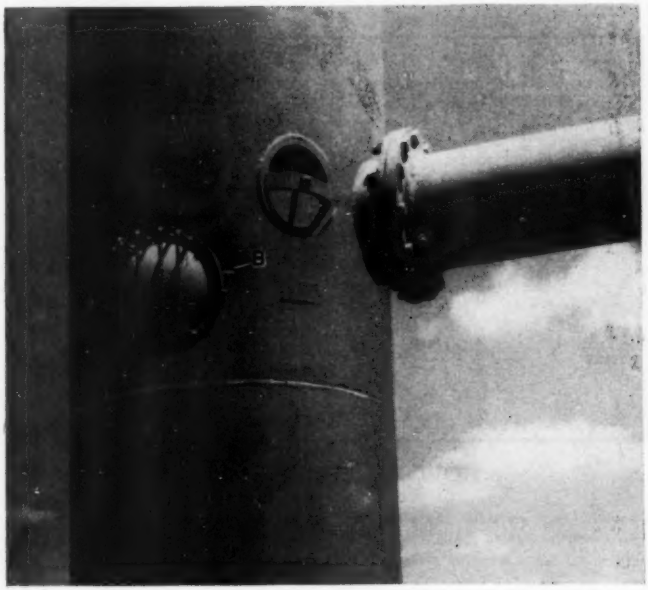
Temperature Switch Keeps Motor From Burning Out

A ¼-hp dc motor on a refrigerator burned out, but we had only an ⅛-hp one to serve as a substitute. We were afraid that the first long cycle to bring the box to normal temperature would burn out the small motor.

To prevent this we bent a piece of strap iron the shape of a telephone head set. At one end we attached a face aquastat and clamped it to the motor's frame. The mercury switch we connected in series in the motor circuit and set the aquastat for 130 F.

When the motor frame reached this temperature the motor was disconnected until it cooled to where the mercury switch closed again. This motor did a good job for about a week until the original motor was repaired.

H H Bryan *Montreal, Que.*



GUARDING MUFFLER RUPTURE DISK

The rupture disk in a gas-engine muffler had to be protected from being hit by material being shifted around, and from being blown free by a backfire in the muffler. To do this one company put a series of formed guards around them as at *B* in the photo. These guards are U-shaped bars of ⅜-in. round steel. They are bent to clear the disk when welded to the retaining flange, and spaced 1½-in. apart to provide maximum coverage.

The disks are eliptical in cross section, designed to yield if pressure rises suddenly within the muffler shell. The disk flange is put in the open area within the shell, below the first baffles which break up the exhaust pulsations and reduce the noise.

Elton Sterrett *Houston, Texas*

Poor Draining Bursts Cylinder Lubricator

A steam engine operated where engine-room temperatures might go below freezing in cold weather. This required a lot of draining to keep water from freezing and bursting equipment.

One night the lubricator was drained as usual, but next morning, after a severe freeze, its tank was frozen and burst. This was quite a mystery until it was discovered that unless the filler plug was removed the lubricator only partly drained.

A little experimenting showed that with only the drain open, water would first run out followed by oil. The latter was taken as an indication that all the water had run out. But not in this lubricator.

With the filler plug in, a vacuum was created in the tank, which held a large part of the water.

Bunyan Kennedy *McCool, Miss.*

Redesigned Fan Drive Gives Rated Speed

One of our ventilating fans was supposed to run at 3250 rpm driven by a 100-hp 750-rpm slip-ring motor. We were unable to get the fan up to expected speed so we tried to find the reason.

A 32-in. dia sheave on the motor connected to a 7.4 in. one on the fan by

Most for your money in FORGED STEEL VALVES

DON'T SETTLE FOR LESS!

Forged Steel valves, because they are small, sometimes don't get the attention they deserve when specifications are drawn.

But the smallest valves, if not equal to the service to which subjected, may be the most troublesome. Therefore, it pays to take the time to analyze design features and to study actual service records.

If you do, you'll find that Edward forged steel valves are the most copied in the field. You'll find that dozens of features that were Edward "firsts" are now accepted as industry standards. But you'll also find that there are still many patented features exclusive with Edward.

Edward pioneered *forged steel* valve construction, and Edward design developments have consistently been a step ahead of mounting service requirements, piling up outstanding service records in some of America's most famous power plants and process installations.

Don't discount experience. For steel valves for pressures from 150 to 7500 lb, expect the best *first* from Edward.

Edward

New design Fig. 444-448 series all forged steel globe and angle valves, 600 and 1500 lb sp, bolted or union bonnets, screwed or welding ends. Fig. 444 illustrated.

Edward

All forged steel welded bonnet Univalves®, 1500 and 2500 lb sp. Integral Stellited seat, Stellited disk, chrome-moly bodies, with permanent or removable backseats for disassembly in the line. Fig. 2224 illustrated.

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a 15-strand V-belt. This works out to a belt speed of over 6000 ft per min. Recommended top speed for V-belts is 5000 ft per min.

The belt's high speed was apparently the cause of it slipping, and when we could not get good operation we decided to change to a flat belt. We installed fiber pulleys on the fan and motor.

These we connected by a 15½-in. wide endless belt made from the best leather and installed the motor on an automatic gravity tension base. This drive cured the trouble and the fan operates at rated speed.

PAUL C ZIEMKE *Oak Ridge, Tenn.*

EDITOR'S NOTE: *There are many cases where flat belts have replaced V-belts and V-belts have taken over the job of flat belts. Practically all of these changes boil down to the same causes: the first application was not properly engineered and the second was. With few exceptions any drive that can be handled by a properly engineered V-belt can also be driven by a well selected flat belt or vice versa. If a drive appears to be a hard one to handle, because of speed or other reasons, consult the manufacturer's engineers. They will be glad to give you the advantage of their vast experience.*

My Biggest Boner

C G Harding, Montreal, Quebec, Canada, didn't make the original boner in this case. But since he didn't do anything about the dangerous condition before the damage was done, let's blame it on him anyway
—ALEC POLLARD

► OUR BOILERS operate at 150 psi. But in the event of pump failure, we could operate with city water at 85 psi, or with canal water which we maintain at 60 psi throughout the building. The canal water is used for lavatories and also for cooling medium in our 3 Freon condensers and our air compressors.

One day the safety valves began to blow. Then we lost most of our Freon charge, a feedwater meter broke, air compressors got red hot from no cooling water, and all the boilers started blowing from low water.

Someone had opened the canal feed valve by mistake. So freon couldn't condense and steam got into the condenser coils. It cost about $1,000 to put things back in shape.

Now we have a check valve in canal line so this can't happen again.

Feedwater Control Saves Waste Heat

BOILER FEEDWATER in our plant includes (1) condensate return from a heating system, (2) makeup from the jacket cooling water of an air compressor, (3) city water when all jacket water is used. All three come into a surge tank. The diagram shows the equipment arrangement to control these supplies automatically.

We try to use all the condensate, then use as much as possible of the hot jacket water from the air compressor, to recover the heat. When these two sources are not sufficient, then we use city water for makeup.

Makeup flow to the surge tank is controlled by a float that positions a valve in the jacket-water and in the city-water lines. Stops on the vertical float rod are adjusted so that the city-water valve does not start to open until there is only about 4 in. of water in the surge tank.

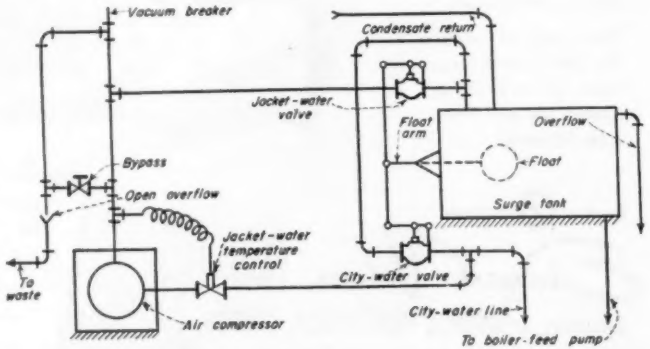
The city-water valve closes tightly before jacket-water valve starts to close. This valve is adjusted to be closed when the surge tank is half full. It is full open when there is 10 or 12 in. of water in the tank.

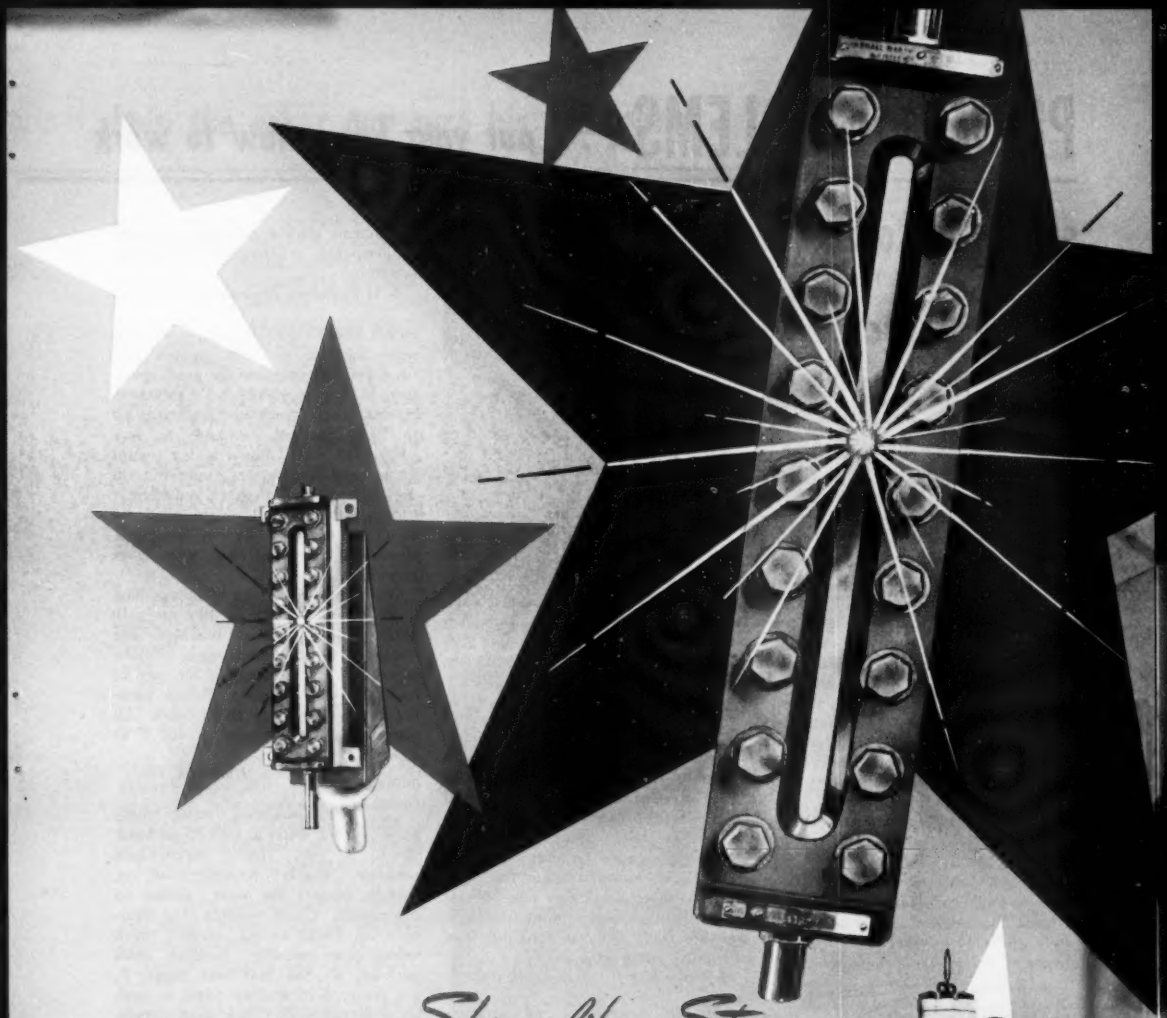
Holding the water level in the tank below half full leaves room to take any flood of condensate that may come along without overflow to waste. Jacket water usually exceeds make-up needs so that the city-water valve seldom opens.

The vacuum-breaker at the high point of the system is a short piece of ¼-in. copper tubing attached to a fitting and threaded into the top end of a tee.

Our surge tank operates at atmospheric pressure with an open vent. If the high point in the air-compressor cooling system can be put high enough to give the necessary hydrostatic head this system can be operated with positive pressure in the surge tank. Then a check valve would be needed in the line to the left of the jacket-water valve.

B P NEEDHAM *Dorchester, Mass.*





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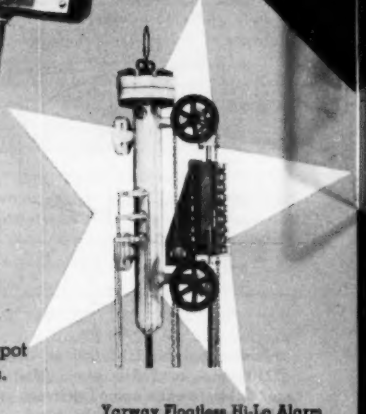
WITH YARWAY TYPE "M" ILLUMINATOR

Now you can *really* see that boiler water level.

Extraneous light, dust particles in the air, deposits on the gage glass—none of these stop the superior penetration of the blue-white light from the Yarway Type "M" Illuminator. It makes the meniscus at water level *stand out like a brilliant star.*

The Type "M" Illuminator is designed to give maximum brilliance, and spot the water level over its entire traverse. It's effective over longer distances.

Equip new or installed Yarway Flat Glass Gages with the Type "M" Illuminator for a new high in easy gage reading. For specifications and prices call your nearest Yarway office or write . . .



Yarway Floatless Hi-Lo Alarm Water Column with Vertical Pressure-Sealed Flat Glass Gage. Equipped with Type "M" Illuminator. For pressures to 2500 psi. See Bulletin WG-1611.

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STEAM PLANT EQUIPMENT * * * **YARWAY**

PLANT PROBLEMS . . . *put your know-how to work*

SHOULD WE OPEN PUMPS FOR INSPECTION?

HERE ARE THE FACTS: In two recent POWER articles on centrifugal pumps, manufacturers' engineers advise readers not to open pumps for inspection as long as they operate right. This doesn't check with our experience and practice.

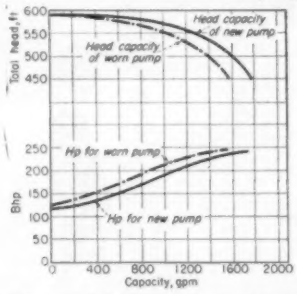
We regularly open pumps for inspection, clearance checks, cleaning and repairs. We get better results than when they run until performance falls off or a sound of trouble is heard.

Should centrifugal boiler feed, water service, sump and other pumps be opened regularly for inspection? At what intervals? Or should pump run until it shows signs of trouble?—JRB, Feb. POWER

HERE ARE THE ANSWERS

DON'T OPEN; LET 'EM RUN. Most designers believe in leaving pump closed until trouble shows up. There are two reasons for opening. (1) Severe and sudden trouble from foreign matter in impeller waterways or pump casing, corrosion or erosion, or mechanical troubles. (2) Internal wear that causes increased leakage losses with a falling off of performance. Original clearances must be restored.

Troubles under first heading are almost all self-evident except for corrosion and erosion. Few pumps have these troubles and you can generally see them in advance. When handling corrosive fluids open pump often enough to learn approximate life of materials. Study effect of internal wear on performance. Curve shows that new pump



against total head of 550 ft. delivers 1210 gpm, uses 210 bhp. After appreciable wear pump delivers only 1000 gpm against 550-ft. head, uses 210 bhp as before. Considering only capacity, worn pump delivers 1210 gpm at 527-ft. head, needs 227 bhp.

Test pump regularly with venturi near discharge or calibrated sharp-edge orifice. Or study power input.

I J KARASSIK *Worthington Pump & Machinery Corp Harrison, N.J.*

. . . Don't open high-pressure (400-1000 psi) high-speed (3550 rpm) multi-stage boiler feed pumps or any other precision-built pump unless trouble pops up.

D T KELLAND *New York, N.Y.*

. . .We have over 850 centrifugals of all types and sizes; more than 60% operate 24 hr per day. We believe it's a waste of time to clean or check clearances of small pumps until they need maintenance because repair costs are small. On larger multi-stage units, assembling rotating element and fitting it to casing requires much time and care. As long as pumps run OK we don't disturb them. Manpower savings are large and we don't run risk of ruining pump balance.

R O BATHIANY *Associated, Calif.*

. . . Fit flowmeters and pressure gages to pumps that are expensive to tear down. Pull them apart only when instruments show it necessary. Inspect simple pumps at infrequent but regular intervals.

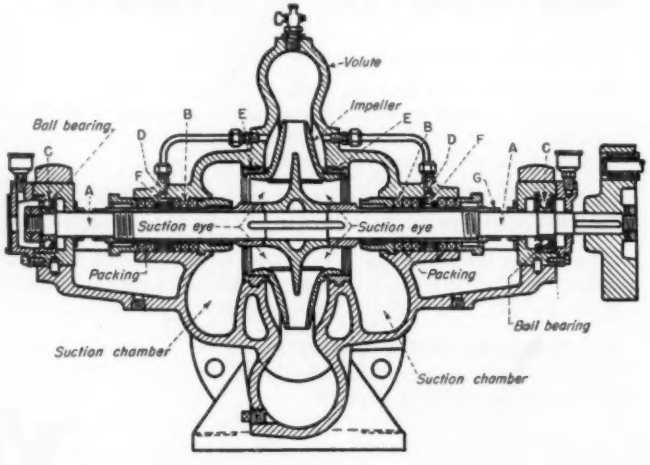
R H FREYBERG *Pleasantville, N. Y.*

OPEN AND INSPECT. Diffusion pumps with medium to high suction lifts need periodic overhaul for good operation. One pump with 14-ft. lift cavitated, needed yearly overhaul. Reducing lift to 7 ft. changed overhauls to once every four years. Leave volute pumps alone until instruments or noise show care is needed. With fresh and slightly turbid water, impellers are good for about 20 years. Renew impellers, sleeves and wearing rings after 20-yr service.

Renew wearing rings of pumps handling unscreened sewage once every 10 years. Clean babbitt bearings and change oil in all pumps yearly. Follow manufacturer's instructions for care of ball and roller bearings. Renew packing about once every three years. All remarks apply to pumps at 160 F or less.

J A COULDEN *Hamilton, Ont.*

. . . Our circulating water pump handles 200 F water against 75-psi head, 20 hr a day. Here's maintenance schedule. *Yearly*: Remove shaft, *A*, sketch; inspect for wear. Order replacements. Check wearing ring clearance, *E*. Clean casing, inspect check valve. *Semi-annually*: Replace shaft packing, *B*. See that seal cages, *F*, are centered in stuffing boxes at seal-water entrance, *D*. Check shaft sleeves, *G*. Check pump and motor shaft alignment. *Quarterly*: Check shaft ball bear-



help the other guy cure his headaches

TYLER HICKS, *Assistant Editor*

ings *C*, for wear. Replace if loose. *Monthly*: Check ball-bearing temperature with thermometer. Record. If high, remove bearing; examine for wear, dirt. *Weekly*: Grease bearings, *C*, with right grease. *Daily*: Check motor temperature, pump bearings, packing.

AL KELLING *Parma, Ohio*

. . . Use record forms for mechanic to fill while he's working on pump. See which tools are needed for job and have them on hand when unit is shut down. Don't use temporary lift rigs; install lifting eyes for hand-operated hoists or build portable rig that straddles pump.

W H MILLER *Lancaster, Pa.*

. . . By all means, open and inspect annually. Otherwise you may have troubles.

W O TATMAN *Ramey, P. R.*
ARTHUR BELTON *Montreal, Can.*
A J BREUGELMANS *Hoboken, N. J.*

. . . Every two years open and inspect feed pumps on 2/3-constant-service and general-service units running continuously. Every five years open and inspect circulating and condensate pumps on 3/4-constant-duty, sump and fire pumps.

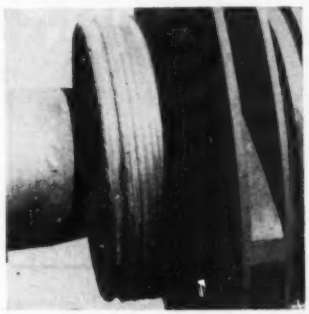
C R WELCH *Chanaral, Chile*

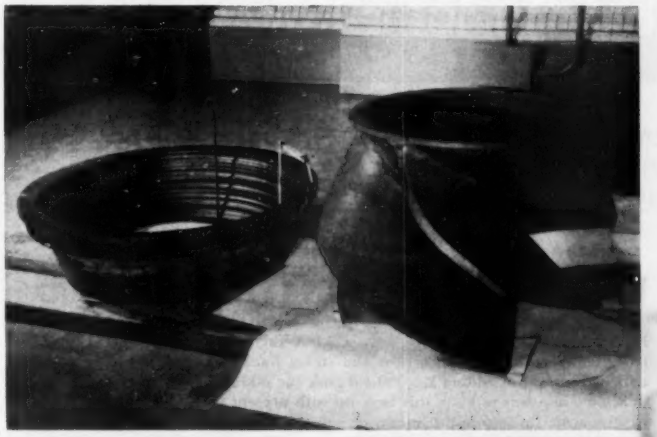
. . . Open pumps annually handling salt water; allow others to run until trouble shows up.

VINCENT STROJSA *Glace Bay, N. S.*

. . . Pumps are the most important auxiliaries in the plant. Maintain according to builder's instructions Open annually, or more often if needed. Inspect, adjust and repair. With large pumps have manufacturer's service engineer supervise overhaul. Photo shows damaged sealing rings we found during annual inspection of a boiler feed pump.

A B KANE *Medford, Mass.*





. . . Photo, *top*, shows troubles we found in sanitation pump after 4½ years service. Wearing rings wore and there were corresponding grooves on impeller. Deepest groove was 7/8 in. Pump had lost about 23% capacity. Photo, *bottom*, shows how large condenser circulating-water pump eroded. Vane sections replaced with Monel metal.

J M LANDS *Chicago, Ill.*

. . . An ounce of prevention is worth a pound of cure. Open and overhaul pumps regularly. Boiler feed, general service and other pumps that operate continuously need overhaul every 3000 to 4000 hr. Let intermittently operated pumps run 4000 to 5000 hr before overhaul. Have spare parts and pump instruction manual on hand when making repairs. Allow only men familiar with pumps to do work. Keep repair records for all pumps.

ALLAN ROCKLIN *Chicago, Ill.*

. . . If pump is idle for long periods, open, clean and oil. This prevents rust. Drain pumps exposed to freezing. Use original thickness and material for casing flange gasket. Trim inner edge carefully and cement to lower half of casing. Don't use too much force to tighten impeller and shaft sleeve nut.

C A WILKES *Oaklyn, N. J.*

. . . Inspect regularly or repairs may cost plenty. Base inspection intervals on time in service, percent load carried

and fluid pumped. Alternate duplicate units; turn all idle units over periodically. When open, check seal and lantern rings, packing, thrust bearings and shaft sleeves. Try out overspeed trip and safety devices, too.

GEORGE MCNALLY *Kearney, N. J.*
GEORGE GRIFFEL *Bronx, N. Y.*

. . . Inspect boiler feed pumps yearly. We inspect them in September so they'll be ready for heating load. If pump has small pipes or tubes to packing, be sure they're clear. Check impeller vanes for cleanliness. See that seal rings don't have excessive clearance. Look for sheared dowels on rings. Impellers must be tight on shaft and keys. Use chemicals to remove impeller scale; chipping is slow and tough, may cause vibration.

Be very careful when removing casing. Chisels or steel wedges may damage machined faces. Use setscrews in tapped holes on top half of casing to jack cover loose. Clean machined faces before reassembling pump. With two or more duplicate pumps, keep impeller and shaft assembly complete with bearings, sleeves and seals on hand. Then you can make repairs in a hurry, if necessary.

R E FONTAINE *Kenmore, N. Y.*

WHAT'S BEST WAY TO INSTALL OIL TANK?

HERE ARE THE FACTS: We have a 3,000-gal fuel-oil tank 75 ft from boiler room. Suction return and steam lines to tank are 3 ft under ground. I'm adding a 5,000-gal tank for more storage.

What's best way to hook this tank up with present tank? Should I run separate lines to boiler room, or connect to lines from present tank, with shutoff under ground? (It gets cold up here in Mass.). Or should I connect two tanks together with a large-size nipple and pump from the one tank?—FMC, Feb, OE

HERE ARE THE ANSWERS

NOT UNDERGROUND. Don't hook tanks together or put any valves underground. I had both in my plant. If you use 3000 gal or less oil in 24 hr it's easy to operate with 1½-in. suction line and 1-in. return line.

Use open return and 15-psi steam to get return up out of tank. Use 2-in. steam feeder, 1½-in. black-iron pipe coil in tank. Trap as close to tank as possible. My 8000-gal tank has 120 ft of 1½-in. pipe fed by 15-psi pump-exhaust line. This is okay when tank is half full or over, but when below half full, oil gets too hot. If your boss will permit, buy thermostat control valve to regulate steam and temperature.

G H WELLS *Kansas City, Mo.*

HERE'S GOOD DOPE. First know state, city, and insurance code. Second avoid completely buried tanks. Pitting, corrosion, and leaks can't be easily checked.

Hook tank with two separate branches to one suction, with valves to control either tank, my sketch. Run separate return line to tanks from pumps. Drain condensate to sump because trying to save little water isn't worth risk if coil leaking oil gets back to various apparatus in plant.

With two tanks of a combined 8000-gal capacity you should have both a truck and a railroad unloading system, as oil cars hold 8000 and 10,000 gal.

With this hookup, oil can balance in tanks by opening two tank valves. With separate return line you can combine supply by pumping out of one tank into the other if only a small amount is in each. Or you can carry two grades of oil in separate tanks if necessary. Mixing is both dangerous and bad practice.

Hookup in my sketch is too large for FMC but it shows how we are ready for most emergencies.

We can load from street, or by railroad car. We can unload from any tank to any other tank in case of either tank being low. We can keep different oils separate. We can get into tanks to inspect. We can drain off any accumulations of water, thereby avoiding burners blowing out from water slugs.

We also keep one tank circulating at all times for standby. Reason is we have only about 30 min to change from all gas to all oil on an average winter load of 100,000 lb of steam.

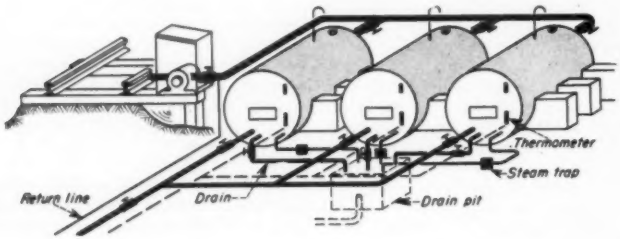
Tank's capacity is 150,000 gallons, hourly rate is from 800 to 1100 gallons.

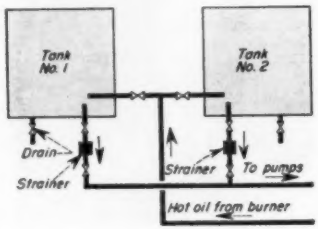
ED J DUFF *Aurora, Colo.*

THINK OF TROUBLES. Run separate oil lines (suction and return) and separate steam lines (steam and condensate) to each tank. Place shutoff valve for each tank in boiler room. In case you have trouble with one tank (leaky steam or condensate line, dirty oil or water in tank) you can shut tank off by closing its valves and opening valves on other tank and still have steady operation.

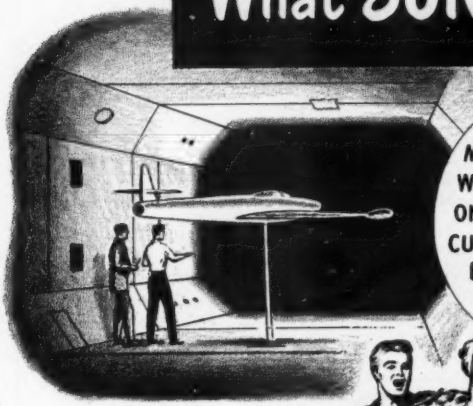
AL KELLING *Perma, Ohio*

HOT OIL TIP. Connect tanks as in my sketch. Notice that there are two valves in each line, one before strainer and one after strainer. This will enable you to clean strainers when one tank is in use and the other tank is filled with oil. Be sure to run return line from burn-



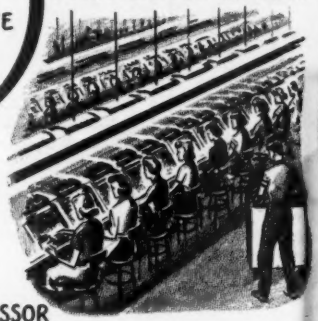


What SUN has done for others...

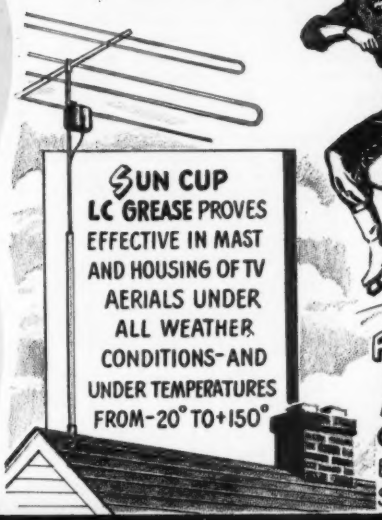


STRATEGIC MULTI-MILLION-DOLLAR WIND TUNNEL DEPENDS ON **SUNVIS** TO OIL-CUSHION THE SENSITIVE BALANCE SYSTEM FOR MEASURING STRESSES

MANUFACTURER OF BUSINESS MACHINES COATS FACTORY AIR SUPPLY FILTERS WITH **SUNTAC**-IMPROVES PURIFICATION BY 50%



SUNISO IN THE COMPRESSOR ASSURES ICE FOR MAJOR SPORTS ARENA (ONE REFRIGERATION FAILURE COULD COST THE RINK $25,000)



SUN CUP LC GREASE PROVES EFFECTIVE IN MAST AND HOUSING OF TV AERIALS UNDER ALL WEATHER CONDITIONS-AND UNDER TEMPERATURES FROM-20° TO+150°

RIVER TOWBOAT SWITCHES FROM OIL TO **SUN ADHESIVE PRESSURE GREASE** FOR STERN-TUBE BEARINGS. RESULTS: COMPLETE SUCCESS, LONGER LIFE, BIG CUTS IN COSTS

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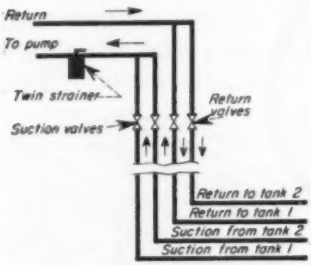
ers, which has very hot oil, to a spot inside tank as close to pump-suction pipe as possible. Then you can run your oil burner without using submerged tank heaters—I have never used ours. Connect the new tank into the present piping, as shown.

C A FREY *Chicago, Ill.*



SEPARATE LINES. I see no good reason for installing shutoff valves under ground or connecting both tanks together with large nipple.

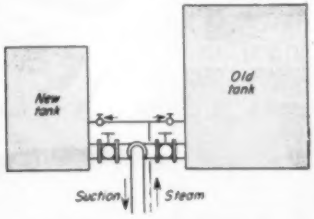
On the other hand, much is gained by installing suction and return valves inside of boiler room in a convenient place near pump.

If valves are installed as in my sketch and individual suction and return lines run to each tank, you won't have to worry about cold outside.

By opening suction and return valves of one tank and closing suction and return of the other tank, you can alternate at will. If one tank accumulates sludge or water, there's always a reserve.

A CANNON *Laurence Harbor, N. J.*

ONE LINE. Best solution to this problem is to use existing line and connect tanks as in my sketch.



Have individual shutoff valves to each tank on suction, return and steam lines. Then you can use either tank as desired or both in parallel. Repairs to one tank or its heating coils can be made without interrupting service.

Make sure all heating lines are wrapped along with oil lines and heavily insulated against cold-weather trouble.

GEO MCNALLY *Kearny, N. J.*

YOUR NEW QUESTIONS

1—Does Cold Air Hurt Tubes and Setting?

WE have a 1000-sq-ft, A-type watertube boiler burning gas and oil in our packing plant. Furnace has a 20x24-in. rear door. Through this door we fire trash (wood, wet and dry paper, greasy sausage peelings, etc.) When burning trash we must admit air through the rear door. Most of the air passes over the trash unused. Also, door is open for long time while firing trash.

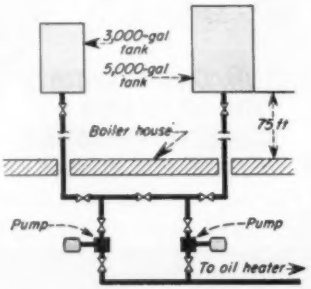
Can this cold air coming in rear door crystallize boiler tubes or harm setting? If so, how can we fire trash without keeping door open? We need sketches of good setups—GFP.

2—How Can I Stop Lamp Vibration?

I'M having plenty of trouble trying to keep lamp replacement in our pulp mill down. We checked voltage in all circuits and found it to be right for the job. In general, lamp locations are favorable except in certain sections of the mill where there is considerable vibration.

At present we use 750-hr incandescent lamps. They burn out sooner than they should. I think vibration shortens their life.

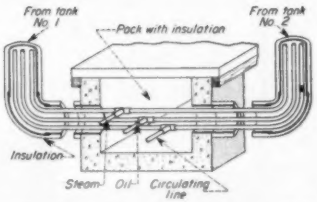
Now what I'd like to know from *Power* readers who have solved this problem is: Can I mount lamps in a way that will reduce vibration of fixtures and bulbs? Or are there special bulbs that I can use where there is severe vibration? Which setup gives longer life? What are the relative installation and operating costs? How are fixtures or other devices that absorb vibration installed on concrete ceilings? Wood ceilings? Can plant electricians do the job? What I need most are installation sketches showing how to do job right. Also a few words of explanation would help us when we do work—YM.



EXTRA LINE-PUMP. The best hookup is a separate line from each tank to the fuel-oil pump, my sketch. Reasons for separate lines are many: you can clean either tank, do maintenance at will without shutting down plant, no spare pump and hookup needed. Cost of running the extra line and installing second pump will pay for itself in trouble-free service.

B D RILEY *Brunswick, Ga.*

CONCRETE PIT. As pipe lines are 3 ft under ground I assume tanks are above ground. Cost of connecting tanks to one line is low, but I don't believe local code



will allow that. Connect in parallel, with a shutoff valve at each tank. First check local ordinances and with your insurance company. Considering safety against shutdown and flexibility of operation and maintenance, the answer to connecting to one line is definitely "No."

If present steam and oil lines are in good condition and properly protected, I see no reason why they should not be used. Where these lines now emerge from ground, dig a pit and pour concrete bottom and side walls to about 10 in. above ground, my sketch.

Make a waterproof cover. Fill pit with good quality insulation, and pack it down. From this enclosure branch out with separate oil and steam lines to each tank. Run lines as close to each other as

(*Continued on page* 204)

Prevent Return Line Corrosion ---- with FILMING AMINES*

HERE'S AN exciting *new* development in the Water Conditioning Field!

Corrosion of steam and condensate return lines is a serious problem to most industrial plants. Such corrosion is caused by the presence of carbon dioxide and oxygen. Up to now, it has been the usual practice to neutralize the carbon dioxide. However, the high cost of this neutralization method has limited its application. And, no protection against oxygen corrosion is assured.

Betz Laboratories have developed a new, advanced process for the prevention of return line corrosion employing *octadecylamine*. This material *does not* neutralize the carbon dioxide. Instead, the amine is adsorbed on the metal surfaces in a monomolecular non-wettable film which acts as a barrier between the metal and the condensate, protecting against both oxygen and carbon dioxide attack. The monomolecular film does not increase in thickness with continued treatment. Results? As high as *99 percent reduction* in corrosion rate has been achieved!

Let a Betz Field Engineer show how you can cut costs in your plant with the use of filming amines. Write today! There's no obligation, of course. W. H. & L. D. BETZ, Gillingham & Worth Sts., Philadelphia 24, Pa. In Canada: BETZ Laboratories, Limited, Montreal 1.

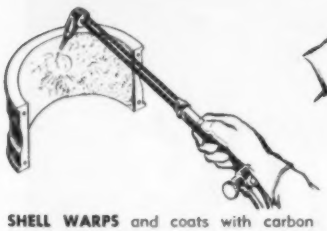
Send for Betz Technical Paper #121, "How Filming Amines Prevent Steam and Return Line Corrosion".

*U. S. PATENT 2,460,289

BETZ

BOILER WATER CONDITIONING • COOLING WATER CONDITIONING • INDUSTRIAL WASTE TREATMENT

ARGUMENTS... here's the place to unload your gripes to



SHELL WARPS and coats with carbon if overheated when removing babbitt

BLANKET OF GAS, when laying on babbitt, keeps oxygen from molten metal

LET'S SETTLE THE BABBITT BATTLE!

IN FEB *OE*, p 53, Mr Jacobs asks, "should open flame ever touch babbitt?" Since *Arguments* gives everyone a chance to express his opinion or ask a question, here is one man's opinion on one man's question.

Babbitt metal will not be injured by open flame. In fact, while the flame is on the babbitt it prevents oxidation of the metal unless allowed to reach an excessive heat. Overheating should never occur when laying on the babbitt, as the job would be ruined if the metal or shell got too hot.

The idea that open flame is injurious to babbitt goes "way back when". Before the acetylene torch came into common use, it was the practice of the helper or apprentice to melt the babbitt out over a coal or wood fire. If he was not cautioned, he would let the shell get red hot. Then he'd lose a lot of the babbitt in the coals and burn the shell. The shell would warp, scale and get so coated with carbon, that it would be impossible to rebabbitt.

For thin liners, the torch method is excellent, but skill and practice are necessary to do a good job. It is most important that the babbitt be melted out of the shell without spoiling the shell for rebabbitting.

If the babbitt is melted out cleanly without warping and leaving carbon deposit, the tinning and babbitting go easy.

F C WINNER *Magnolia Metal Co*
Elizabeth, N. J.

HARVEY WELCH is right (Nov 1950, *OE*, p 34, and Feb *OE*, p 53)! Bearing shells can be babbitted the way he describes —*provided* the proper technique is used.

The success or failure of this operation depends on the type of flame used on the metal. So a description of flame is in order to illustrate the facts.

A flame is defined as a body of burning gases (in motion).

There are three types of flame, namely: (1) Oxidizing—carrying an excess of oxygen and having the ability to convert a metallic substance into an oxide. (2) Neutral — supplying just enough oxygen to unite with the other gas or gases and leave no free oxygen in the products of combustion. This one is often sought, but seldom found. (3) Reducing—having a definite shortage of oxygen. This flame has the ability to convert a metallic oxide back to metallic form by drawing the oxygen out of the metal.

The secret of this last flame is in keeping the flame adjusted just below neutral so no excess oxygen is present. At the same time the tip of the torch must be held far enough from the work to give the oxygen time to combine with the carbon and hydrogen before it makes contact with the babbitt.

All elements used to make babbitt oxidize very rapidly near or at the melting point. For this reason, oxygen must be kept away at this stage of the operation. This is done by blanketing the molten surface, either with the neutral part of the flame or with the neutral products of combustion just beyond the tip of the flame, until the molten metal has again solidified and cooled below the oxidation point.

A lot of data are available from manufacturers of welding gas and supplies about torch welding in all its ramifications. And it's free. To get more facts write to Air Reduction Sales Co, 60 E 42nd St, New York, N. Y.; The Liquid Carbonic Co, 3100 S Kedzie Ave, Chicago, Ill.; Modern Engineering Co, Inc, 3401 Pine Blvd, St Louis, Mo.

Two manufacturers that I know of even maintain a free instruction service. A welding engineer will come at your request and give specific instructions on welding technique for any type of weld.

SCHUYLER PAGE *Buffalo, N. Y.*

Watch Health Code on Your Pump Connections

IN THE March issue of *OE*, p 42, I note that one method of priming a centrifugal pump is by use of city water. This is known as a *cross connection*. Please note that it is also a violation of the Health Code of the State of New York —unless the pump is handling a potable water, the sanitary quality of which is checked at suitable intervals by proper authorities.

R G YAXLEY *Supt, Waetr Comm*
Waterford, N. Y.

Head Filing, Cake, Gin and Frogs

WHEN I READ of Marmaduke Surfaceblow eating a whole cake and washing it down with Sandpaper Gin, I somehow doubted the veracity of the narrator. But now this man A A Ross of Philadelphia says he keeps all his plant records in his head.

Which one of those yarns would you say took the prize?

And that business of looking at a machine and telling whether it needs overhauling is like looking at a frog and telling how far he will jump. There is apt to be some little bit of uncertainty attached to both acts.

J E GLEASON *Eng, Evans Prod Co*
Plymouth, Mich.

Here's a Super Boner

I MUST have gotten off to a bad start that morning. It was back in 1931. I was working for the Baltimore Transit Co, overhauling controllers and motors. I got an order one day to put a tension of 25 lb on all trolley wires, at a distance of 15 ft above the ground.

editors, manufacturers, fellow engineers

ALEC POLLARD, *Assistant Editor*

I got a helper, a scale, a steel tape and started to work. I got on top of the car, and my helper stayed on the ground. First I fastened one end of the tape to the scale and hung the scale on the trolley wheel. Then I lowered the other end of my tape to the helper so that he could contact the rail while I adjusted the spring-adjusting nut on top of the car and kept an eye on the scale.

WHAM!! BAM!!!!! A blinding flash was all I saw. And I didn't see that for long. The next thing I knew, I was being carried to the Mercy Hospital for treatment.

I was in that hospital for three weeks. My helper was knocked down and burned about the hands and arms.

PS: Here's what I should have done: (1) I *should* have pulled the trolley rope down. (2) I *should* have pulled overhead breaker switch. (3) I *should* have used rubber gloves. (4) I *should not* have used steel tape around dc.

LEON GRIMES *Engineer*
Kalamazoo, Mich.

EDITOR'S NOTE: *I hope reader Grimes meant to imply that he wouldn't use steel tape around ac either—I'd hate to see him back in the hospital again.*

"I MUST HAVE gotten off to a bad start that morning . . ."

Has Anyone Tried Potato Peelings and Beer Cans?

ON PAGE 30, March *OE*, John Hyler gives a lot of information on different kinds of packing. What I want to know is—why all the fuss about packing?

In college we had to learn too many important things to fool with details. My dad, whose been an operating engineer for 35 years, says we were right. In his day they packed water glands with flax packing and tallow; for steam they used asbestos and graphite; for oil, leather; and for ammonia, anything they could get their hands on.

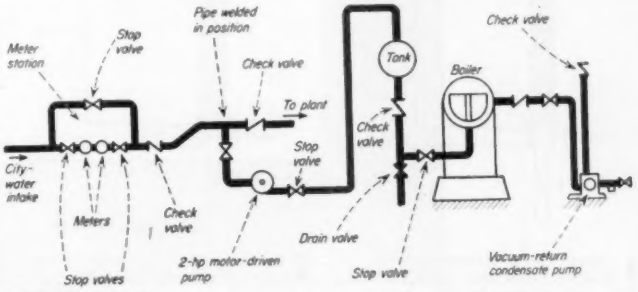
Last year I stopped a badly blowing steam gland on a construction job by cutting up my old felt hat and stuffing it around the rod. She worked fine.

They keep license requirements down so the first monkey that comes in off the street can get a plant operator's job. And plant owners pay broken down carpenters and bricklayers more than they do operating engineers.

I repeat—why should we worry about packing wearing out?

A A YARBROW *Dallas, Tex.*

EDITOR'S NOTE: *Maybe I'm crazy. Is there a reader in the house who can answer Mr Yarbrow properly?*



USING CITY WATER, as shown here, or operating without the tank and having a low-water-cutoff-switch connection to the booster pump, this system will work okay

Gorrie Has a Few Things to Say . . .

. . . TO L E PILE:

ANY BOILER that uses city water, March *OE*, p 53, should be equipped with a low-water cutoff switch. If not, then it should have a combination feedwater regulator and low-water cutoff switch for mechanical firing.

What about your condensation returns—was there no vacuum- or condensate-return pump?

I would suggest that you have a small booster pump connected to the city-water main, sketch above.

. . . TO A A ROSS:

THE TROUBLE nowadays is that there are not enough men with super cerebral cavities (March *OE*, p 53).

The large-cavity brain is a thing of the past—and high time too. Too many would-be engineers gloried in their capacity for storing stuff in their noodles. The wrong stuff!

I've come across a few of that ilk—the kind that can store everything in their craniums (to the detriment of the men under them). These crackerjacks with the big brains actually buggered up the works.

. . . TO A L SCHNIDERING:

I went to a big plant once that was owned and operated by one of the largest organizations of its kind. I showed the manager my licenses—Gold Seals for N J, Ohio and Detroit.

"Neither the State nor the City is 'bound' by licenses," he said.

This was in a state where boilers and air receivers are allowed to operate the best way possible. Boiler shells have welded cracks, and air receivers have welded patches slapped on by any Tom, Dick or Harry. State inspectors even back them up.

JOHN M GORRIE *Sandston, Va.*

Marmaduke's Mailbox

As a shift supervisor in a central generating station of 100,000 kw, I run into plenty of humorous incidents. As for Marmaduke Surface-blow—all I can say is, I hope his stories keep coming forever.

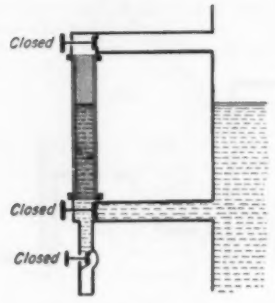
A W SHEPHERD *San Diego, Calif.*

I read Marmaduke's stories and get a big kick out of them. In my many years' experience in this field, I find that few people have attained success telling these stories. They seem to be the most difficult to write.

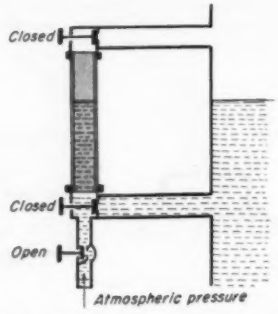
S C PAGE *Buffalo, N. Y.*

HOW TO CLEAN BOILER GAGE GLASS

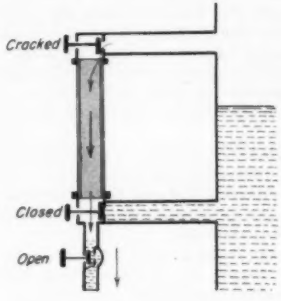
By ART CANNON, *Laurence Harbor, N. J.*



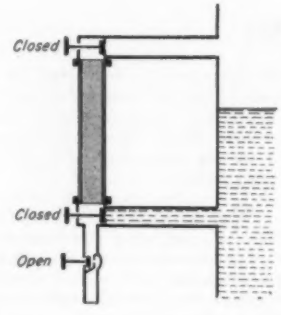
1 Close top and bottom gage valves of working boiler when gage glass gets dirty and you want to clean in a hurry



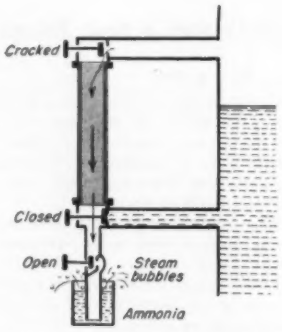
2 Open drain valve on drain line under glass. Water may not drain because atmospheric press. is working against it



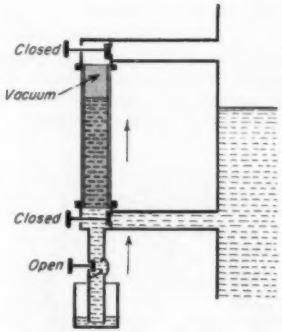
3 Crack top gage valve so steam pressure from boiler blows water out drain line. Idea is to have only steam in glass



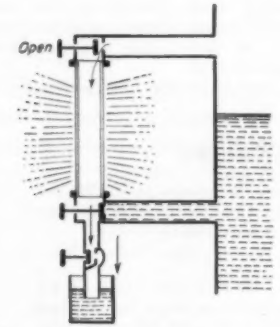
4 Close top gage valve soon as all water is out of glass and drain line. Fill cup with ordinary household ammonia



5 Hold cup under drain line and crack top gage-glass valve slightly until steam bubbles up through the ammonia



6 Close top gage valve. Steam condenses in glass quickly and ammonia is forced up into glass right up to the top



7 If glass is not clean enough, repeat these operations a few times until glass is perfectly clean and sparkling

'TRICK' CLEANING IN PLACE

► Gage glasses on small boilers are often coated with rust or some other opaque matter. And the glass is usually left that way year after year. Finally it gets so bad that telling the right water level is a tough job. Glasses on larger boilers usually get more attention.

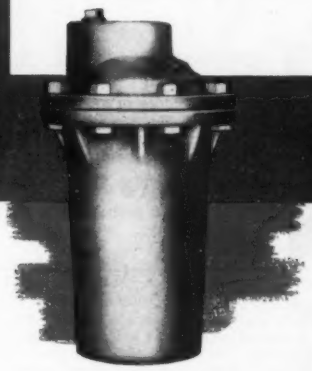
There's no reason for dirty glasses because they can be cleaned in a jiffy *without removing glass from column.* How? First fill a cup or tumbler with ordinary household ammonia. With steam on boiler, close both top and bottom gage valves and open drain cock. Then crack upper gage valve until water leaves glass, then close. Immerse drain line in ammonia, then crack upper gage valve until steam bubbles out of ammonia, then close valve.

Steam in glass will condense and create a slight vacuum. That causes ammonia to be forced up into glass by atmospheric pressure. Repeat until glass sparkles. This operation takes only a few minutes—leaves no excuse for dirty glasses.

NO STEAM LOSS

FROM ZERO TO FULL LOAD

ARMSTRONG TRAPS DON'T PASS STEAM



UNLIKE some devices, Armstrong traps will not pass steam, regardless of load conditions. The diagrams at the right show this conclusively. Under no-load conditions here is what happens: steam in the bucket eventually condenses due to radiation loss. When enough condensate is formed in this manner to cause the bucket to lose buoyancy and sink, the trap empties itself and the cycle repeats. The radiation loss is small—as it would be in any device of similar size. There is no steam loss!

When there is a condensation load, the operation is the same except that the trap remains open until all condensate flowing into it is discharged.

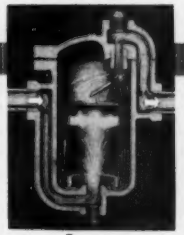
Freedom from steam loss saves fuel, keeps down back pressure in return lines. Call your nearby Armstrong Representative for the traps you need now.

ARMSTRONG MACHINE WORKS

812 Maple Street • Three Rivers, Michigan

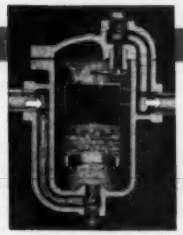
OPEN

When accumulated water causes bucket to lose buoyancy, trap opens wide.



CLOSED

After condensate is discharged, steam entering bucket causes it to float, closing the valve tight. Valve remains closed until steam condenses.



SEND FOR THE 36-PAGE STEAM TRAP BOOK. It tells you how to do the best possible trapping job with facts, figures and diagrams.

ARMSTRONG STEAM TRAPS

HEADWORK

PHIL SWAIN BRINGS ENGINEERING THEORY DOWN TO EARTH

How Forces Balance—2

► LAST MONTH we saw how forces balance—meaning how they add up to zero. If any point in a machine or structure is standing still or moving in a straight line at constant speed you can be sure that the forces at that point are in balance. Otherwise the point would start moving, speed up, slow down or start curving.

In all cases considered last month, and here, the forces are all in the same plane and all act through the same point. (That is, the lines of action of all the forces intersect at one point.)

Let's repeat the rules for such cases:

1—The *resultant* is the single force that is equal to the lot.

2—Any force can be represented by an arrow whose length is the *amount* of the force, to scale, and whose direction is the *direction* of the force.

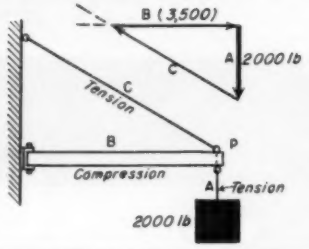
3—To get the resultant "add" the individual forces by placing the arrows end to end (without changing direction), so they form a figure like a zig-zag one-way street, with all arrows running as in one-way traffic.

4—The *resultant* is an arrow drawn from the butt end of the first arrow to the tip of the last.

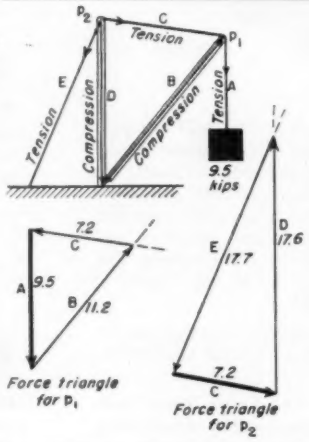
5—*If the forces are in balance the resultant must be zero.* In that case the figure just described will be a complete triangle or polygon. That is, the tip of the last arrow will just reach the butt end of the first arrow, so that the figure "closes".

Thus, to find the unknown forces at a point, use the given data to draw the force triangle or polygon. Then scale the unknown forces from this figure.

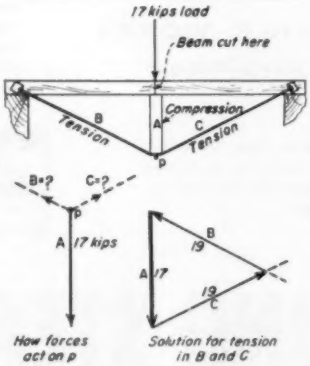
Each example on this page involves three forces. One force is known completely. The directions, but not the amounts, of the other two are known. The sketches and captions show how to complete the triangle in each case. You then measure the unknowns directly from the completed triangle.



1 Three forces act in one plane through point *p* at end of jib crane. They balance so triangle must close. First draw *A*, 2000 lb acting down. Then complete the triangle by drawing sides *B* and *C* parallel, respectively, to beam and tie rod of crane. *B* scales 3500 lb and *C* 4100 lb. Note that *C* pulls up to left (tension), and *B* pushes out to right (compression)



2 First construct triangle for point p_1. Draw known force of 9.5 kips (9500 lb) straight down. Then draw *B* and *C* parallel to *B* and *C* in derrick. Note that arrows run "around". Tension in *C* measures 7.2 kips while *B* scales 11.2 kips compression. Tension *C* (reversed) is repeated in the triangle for point p_2. Draw this and then complete as before, scaling *E* as 17.7 kips tension and *D* as 17.6 kips compression. Now all forces are known.



3 In this elementary bridge the beam would normally be continuous over the strut. To keep the problem simple it is assumed to be sawed through at this point, so that the full load of 17 kips is transmitted directly to point *p*. Complete the triangle and draw rod tensions *B* and *C*. Then measure their 19 kips tension.

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protects the power for the world's biggest drink

For thirsty New York, the Delaware Aqueduct of the New York City Board of Water Supply performs a service that dares not fail. Hence, Everdur Electrical Conduit is used to protect feed wires for sluice gate motors, pump motors and recording instruments in corrosive locations. Thousands of feet of ¾" and 1" RC and EMT are in service at control stations and inspection elevators along the 117-mile tunnel. Junction boxes in important locations are also made of Everdur*. . . Anaconda's corrosion-resistant copper-silicon alloys.

Everdur Conduit has performed impressively on the Delaware River Bridge and in the Pennsylvania Turnpike tunnels where, for many years, it has been exposed to highly corrosive conditions. Installations made since 1933 have shown that where ordinary conduit fails in months, Everdur Conduit lasts for years. It is available in two wall thicknesses: rigid conduit (RC) in nominal sizes from ¼" to 4" inclusive; and the thinner-walled electrical metallic tubing (EMT) in nominal sizes ½" to 2" inclusive.

Write today for your copy of Anaconda Publication E-12 containing detailed information on Everdur Conduit. Address: The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

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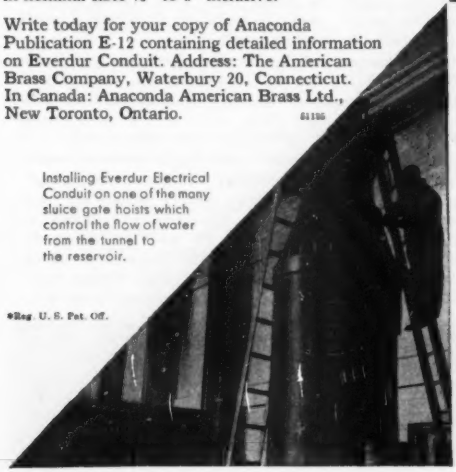
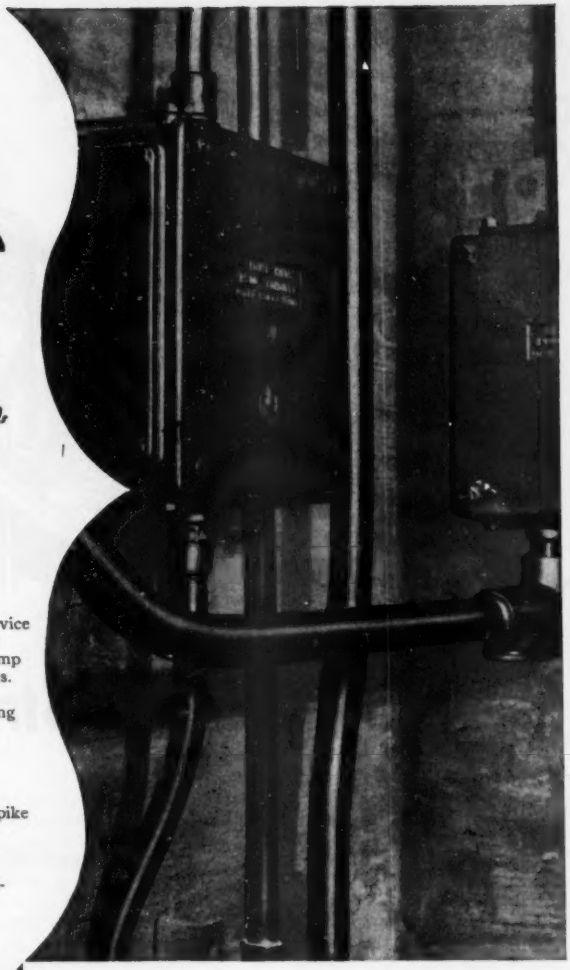


Installing Everdur Electrical Conduit on one of the many sluice gate hoists which control the flow of water from the tunnel to the reservoir.

*Reg. U. S. Pat. Off.



Everdur Conduit, 1" RC and 3/4" EMT in deep service shaft, Kensico Reservoir control station. Junction boxes are cast Everdur manufactured by Crouse-Hinds.

wherever corrosion resistance counts

consider **EVERDUR ELECTRICAL CONDUIT**

ANACONDA®

Marmaduke Strikes Gold

►MARMADUKE SURFACEBLOW is a very quaint old buzzard. He twists every engineering problem into terms of personal experience and ties it up with various characters. But that's probably the big difference in strictly theoretical engineers and practical operating men.

To one, machinery means textbooks, graphs, data and a slide rule. To the other, it's Grindstone Gus's advice about pulling cylinder liners; George Bailey's bonehead stunt of setting valves and then forgetting to move the rocker arm so the pump could start. Or he remembers how Old Gilhooly sweated for hours to start the feed pump when the exhaust valve was shut all the time.

But we're all interested in screwball experiences, especially when these yarns happened in the 'good old days.' That's why we take our friends to Bedlam's Bent Propeller Bar for lunch. There's always a chance that old fossil, Marmaduke Surfaceblow, may sound off.

Yesterday Ed Duff blew in from Aurora, Colorado, so we took him in tow to our favorite joint. Ed is an old timer who did everything from firing boilers at the McAlpin Hotel thirty-five years ago, to trouble shooting for a boiler firm.

Ed and I sat around in the Bent Propeller Bar, eating and reminiscing, when a horny-handed tug-boat engineer at the bar opened his yap.

"These new tugs are so automatic you can go to sleep at the throttle and she'll still answer the old man's bells," he started, putting down his glass. But that's as far as he got.

Marmaduke, holding down his usual end of the bar, slammed down his bottle of Sandpaper Gin, turned his back to the bar, and bellowed in his foghorn voice, "BILGEWATER ON GOING TO SLEEP WITH AUTOMATIC EQUIPMENT."

He stopped there for a moment, turned his head slowly from one end of the room to the other, glaring at his audience. Satisfied no one cared to argue the point, he blasted away.

"Back in the summer of 1904 I piled off an Alaskan steamer in Seattle and headed for Central City, Colorado. There was supposed to be plenty of gold left around for anyone who cared to dig for it.

"A week later, I was taking on ballast at the famous Teller House Bar in Central City and listening to a coupla miners talk about a mine cave-in. A lanky stranger in fancy clothes, wearing sideburns and paintbrush mustache, came over and poked me in the ribs.

" 'Ever hear of the flooded Americus Mine down the road?', he asked, out of a clear sky.

" 'No,' I answered, giving him the once over.

" 'Well,' he explained, 'six miners were drowned when she flooded back in ninety one.' Then before I could open my mouth he introduced himself as Bill Lovell.

" 'I'm headed down Cripple Creek way to Victor tomorrow,' he informed me. 'I've got a claim down there on a sure thing, and I need a partner with shoulders like yours. What do you say?'

"After a few drinks we shook hands. Next morning we started for Cripple Creek. Down there I learned my partner was a fake who was known as *Chicken Bill*. He made his money by salting mines. He bragged of salting and selling the Chrysolite mine to Senator Tabor, who had cleared about $15,000,000 in Leadville on another deal.

"We parted company right there. I took the old narrow gage Florence & Cripple Creek railroad down to Victor that afternoon by myself. I no sooner washed the alkali dust out of my breeching at the Diamond Bar in Victor that

(*Continued on page* 198)

Nalco

Route to Your Plant Process Engineers:

BOILER WATER (AND PROCESS) ANTIFOAMS

☆ **CLEAN STEAM** results when you use Nalco Antifoams . . . No carry-over . . . No scaling of traps or valves.

☆ **LESS BLOWDOWN** with Nalco Antifoams because much higher dissolved solids concentration can be safely carried.

☆ **PROCESS USES** of Nalco Antifoams are saving time, trouble, money in more and more plants . . . Do your Process Engineers a favor by passing this ad on to them—Nalco Antifoams react in much the same way in many process liquids as they do in boiler water!

Nalco Antifoams are the chemicals which can bring you this modern economy. They are fed directly into feedwater or boilers with other water treatment compounds, or independently, in dosages of *only 5 to 8 parts per million!*

The use of Nalco Antifoams has consistently enabled boiler operators to double, triple or even quadruple previous concentration limits . . . and at the same time produce cleaner steam.

Tests in an operating 70,000 lb./hr. boiler (see water analysis below), with 8 p.p.m. Nalco antifoam, failed to produce carryover when dissolved solids concentration *exceeded 25,000 p.p.m.!*

If your antifoam performance is less than you can get with Nalco Antifoams, act now to cut operating costs.

TEST BOILER WATER ANALYSIS at beginning of no-blowdown run, in p.p.m.: H-O, P-720, M.O.-750, Cl-900, SO_4-1420, PO_4-40, DS-3350, S.S.-Trace.

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THE *Nalco* SYSTEM

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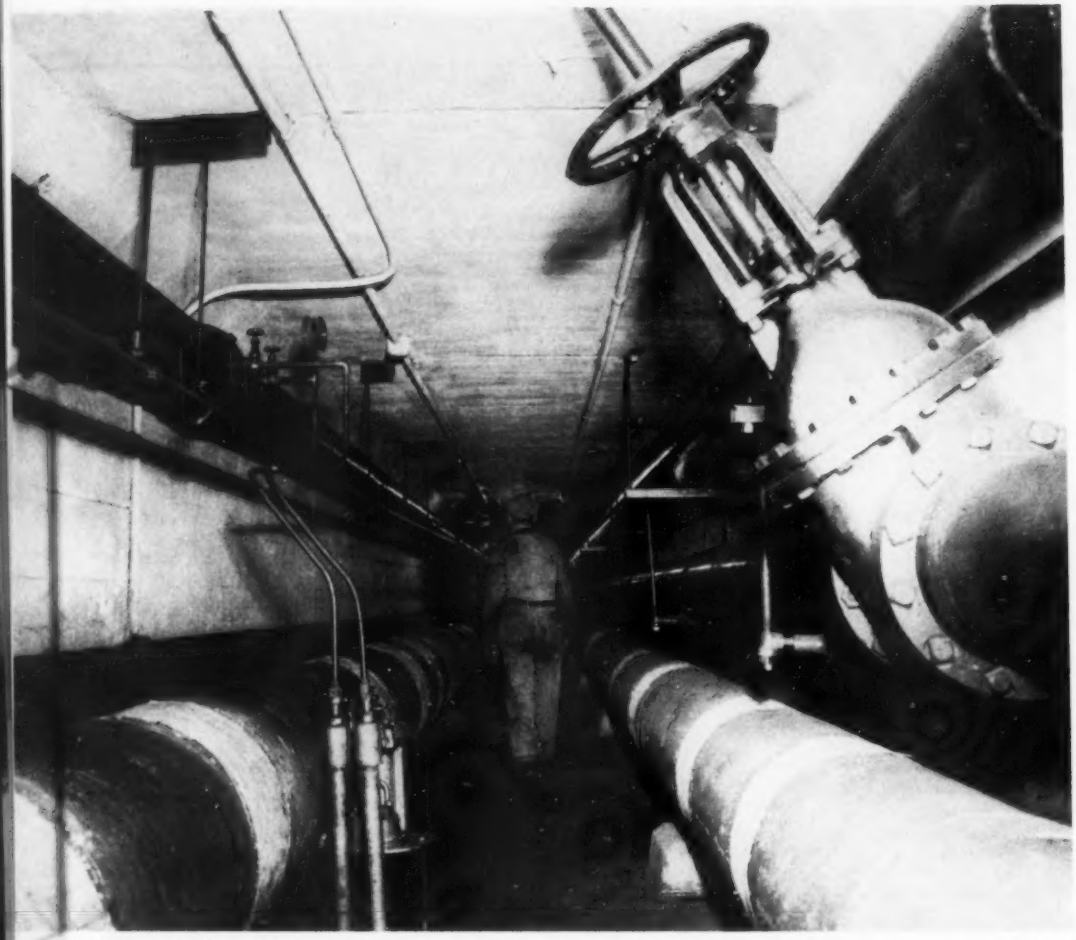

HALF-MILE-LONG TUNNEL connects powerhouse to main factory plant, supplies low- and high-pressure steam, compressed air

...Bring Power Services to Process

► GENERAL MOTORS' Fisher Body Div power plant at Pontiac, Mich. serves as the source of power services for both the Fisher plant and the nearby Pontiac Motor Div main factory. A tunnel, *photo above*, just under a half mile long, supplies the Pontiac plant needs.

Main elements in this tunnel are steam lines, high and low pressure, a compressed-air line service, and a condensate-return line. It takes a 12-in. line to handle the 150-psi high-pressure steam demands and an 18-in. pipe for the 8-psi heating load. The air lines are 10 and 12 in., respectively; the condensate return, 8 in.

Two more steam pipes, in addition to those in the tunnel, a 16-in. high-pressure line and a 31-in. low-pressure one go overhead to the Pontiac plant.

Condensate-return pumps spotted throughout the main factory plant deliver condensate back to a central storage tank in the powerhouse. Here it is treated with soda ash and alum, and filtered to remove entrained oil.

ANOTHER NOTABLE ACHIEVEMENT IN SERVICE LITERATURE BY JENKINS

THE NEW

BOOK No. 2

Nos. 26—50

practical piping layouts

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Number 227

Temp, F	Pressure, psia						
	Sat.	1000	2000	3000	4000	5000	6000
32	500.6	502.2	504.1	505.7	507.3	509.3	510.9
100	497.3	498.8	500.7	502.4	503.2	504.8	506.0
110	496.3	497.8	499.7	501.2	502.2	503.7	504.9
120	495.2	496.8	498.6	500.0	501.2	502.5	503.7
130	493.8	495.4	497.2	498.5	499.8	501.1	502.4
140	492.4	494.0	495.8	497.1	498.4	499.7	501.1
150	490.9	492.7	494.3	495.7	497.0	498.3	499.7
160	489.3	491.0	492.6	494.0	495.4	496.8	493.2
170	487.6	489.3	491.0	492.4	493.8	495.3	496.7
180	485.9	487.5	489.2	490.6	492.1	493.6	495.0
190	484.1	485.7	487.4	488.8	490.3	491.8	493.3
200	482.3	483.8	485.5	487.0	488.5	490.0	491.5
210	480.3	481.8	483.6	484.9	486.1	488.1	489.7
220	478.3	479.7	481.6	482.7	483.6	486.1	487.8
230	476.2	477.6	479.6	480.8	482.0	484.1	485.8
240	474.0	475.5	477.6	479.0	480.4	482.1	483.8
250	471.8	473.4	475.5	477.2	478.7	480.0	481.7
260	469.4	471.1	473.2	475.0	476.4	477.8	479.7
270	467.0	468.8	470.9	472.7	474.1	475.6	477.4
280	464.6	466.4	468.5	470.2	471.8	473.4	475.2
290	462.1	464.0	465.9	467.7	469.5	471.1	473.0
300	459.6	461.5	463.4	465.2	467.1	468.8	470.7
310	456.9	458.9	460.9	462.8	464.6	466.4	468.2
320	454.2	456.2	458.3	460.3	462.1	464.0	465.7
330	451.4	453.5	455.7	457.7	459.6	461.5	463.3
340	448.6	450.7	453.0	455.0	457.0	458.9	460.8

Temp, F	Pressure, psia						
	Sat.	1000	2000	3000	4000	5000	6000
350	445.8	447.7	450.1	452.1	454.3	456.2	458.2
360	442.7	444.8	447.2	449.3	451.5	453.6	455.2
370	439.6	441.8	444.3	446.4	448.7	450.9	452.1
380	436.5	438.7	441.2	443.4	445.7	448.0	449.6
390	433.4	435.6	438.1	440.4	442.7	445.1	447.0
400	430.3	432.4	435.0	437.3	439.7	442.2	444.4
410	427.1	429.2	431.8	434.2	436.5	439.2	441.5
420	423.8	425.9	428.6	431.1	433.3	436.1	438.5
430	420.4	422.3	425.3	427.8	430.1	433.0	435.4
440	416.9	418.7	421.9	424.5	426.9	429.9	432.3
450	413.4	415.0	418.5	421.1	423.6	426.7	429.2
460	409.5	411.1	414.7	417.5	420.2	423.3	425.9
470	405.5	407.2	410.9	413.8	416.8	419.9	422.6
480	401.2	402.8	406.7	409.8	413.1	416.2	419.1
490	396.9	398.3	402.4	405.8	409.3	412.5	415.6
500	392.6	393.8	398.1	401.8	405.5	408.8	412.0
510	387.8	388.9	393.4	397.4	401.4	404.9	408.4
520	383.0	384.0	388.7	392.9	397.3	400.9	404.7
530	378.0	378.8	383.5	388.3	393.0	396.8	400.9
540	373.0	–	378.3	383.7	388.7	392.7	397.1
550	367.9	–	373.0	379.0	384.4	388.6	393.2
560	362.4	–	367.5	374.0	379.7	384.3	389.1
570	356.8	–	361.9	369.0	375.0	380.0	385.0
580	351.0	–	356.0	363.6	369.9	375.2	380.5
590	345.2	–	350.1	358.1	364.7	370.4	375.9
600	339.4	–	344.2	352.6	359.5	365.6	371.3

SATURATED AND COMPRESSED WATER

Converting Gpm to Lb Per Hr

►WEIGHT OF WATER in given volume depends on both temperature and pressure. Here are conversion factors for figuring pounds-per-hour from gallons per minute, or vice versa. This table is based on a gallon of 231 cu in. and the compressed liquid table from *Thermodynamic Properties of Steam*, by Keenan and Keyes. To use, simply find factor by looking up water temperature in left-hand column and then follow to the right under the proper pressure. Use this factor in the formula:

$$\text{Lb per hr} = \text{factor} \times \text{gal per min}$$

or

$$\text{Gal per min} = \frac{\text{lb per hr}}{\text{factor}}$$

Intervals in pressure and temperature are small enough to enable making interpolations mentally. Accuracy will be suitable for most engineering jobs.

Example: Find flow in lb per hr for rate of 600 gpm of water at 320 F and 2500-psia pressure.

In table find 458.3 at 2000 psia and 460.3 at 3000 psia. Interpolating, the factor at 2500 psia is 459.3. Then $600 \times 459.3 = 275{,}580$ lb per hr.

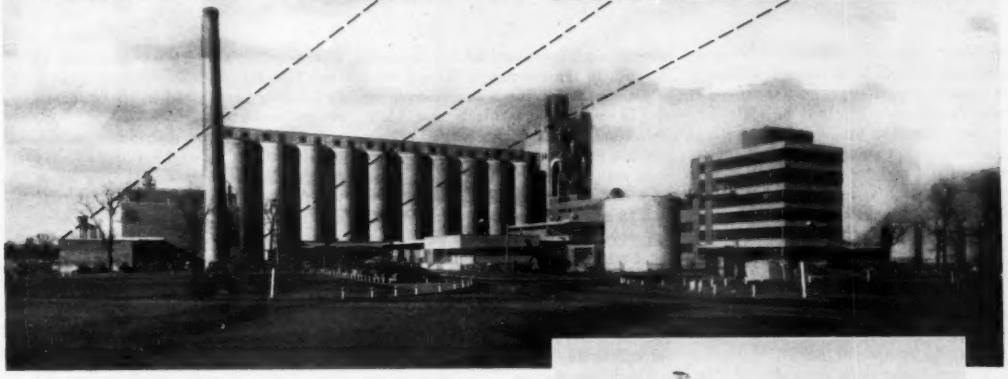
F M KAMARCK, *New York, N. Y.*

FAIRFIELD SERVING THE NATION'S POWER PLANTS

CLOSE-UP of a modern boilerhouse

Boilerhouse design and construction is of prime importance in the planning of any industrial plant—and equally important is the coal and ash handling system required to properly serve such a boilerhouse.

In the case of the "by-product" oils processing plant illustrated here, located in Minnesota, Fairfield Engineers were called upon to construct the coal handling system early in the plant's conception. In close cooperation with the plant builders and company engineers, a Fairfield system utilizing a track hopper—apron feeder—bucket elevator—enclosed flight conveyor—suspension bunker and motor-driven weigh larry has been installed that meets the requirements admirably. A Fairfield engineer's "Boilerhouse" construction experience can serve YOU as well—either for expansion of a present system or planning for new facilities. Call or write today for his "cost-cutting" recommendations, or a copy of Fairfield's latest Bulletin No. 650.



A view across the top of the boilerhouse showing bucket elevator and enclosed flight conveyor.

FAIRFIELD

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MARION, OHIO

READER SERVICE SECTION

POWER NEWS 152
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PLANT EQUIPMENT NEWS 158
NEW FREE BULLETINS 167

MAJOR EQUIPMENT MANUFACTURERS in the power field have developed special programs, including films, literature to meet industry's need for faster employe training, quicker, easier-applied tips on equipment selection and maintenance

Manufacturers Join in Maintenance Fight

► WITH TODAY'S PREPAREDNESS program the emphasis throughout industry is placed on greater production from all plant equipment. One way of achieving such an aim is to prolong the operating life of working equipment through better use and maintenance.

Several manufacturers have been anxious to pass along to the users of their equipment the tips they have accumulated over the years. These tips range from initial steps to take in selection and application to suggested maintenance procedures. All are collected and presented in methods felt most beneficial to the equipment user.

Photos above show examples of this class of help from three separate manufacturers. Photo, *left*, is from General Electric Co on a training course offered industry in selecting and applying modern electric motors (more below). The middle illustration is a "Fight Waste" campaign launched by Henry Disston & Sons, Inc to insure better use and life of plant tools and the photo, *right*, is a package plan put out by the Quaker Rubber Corp Div of H K Porter Co.

General Electric Co. As an aid in the fast training of industrial personnel charged with selecting and applying modern electric motors, GE has released the 15th in the company's *More Power to America* series. It is a course made up of (1) nine 35-mm black and white slide-film lessons (2) student review booklets on each lesson, (3) an instructor's manual. Each film lesson takes from 15 to 30 min and is accompanied by a 16-in. sound recording of the script.

Student booklets are to be passed out for home review to those taking the course. They contain reprints of the slide-film scripts with key pictures, quick review outlines, and sets of test questions. The 96-page instructor's manual will enable any competent engineer to teach the course. This manual includes complete instructions on how to plan and set up each lesson, projection information, and complete scripts and pictures for all nine slide films. It also contains questions and answers to accompany review frames attached to each film, reference sources and answers to questions contained in the student's review booklets.

Program will be distributed to GE district offices throughout the country for showings to interested groups. These will include users and potential users of electric motors, application engineers, power sales engineers, machinery manufacturers, designers, contractors, consulting engineers, and students.

The entire kit, consisting of nine slide films, one instructor's manual, and ten copies each of the nine student booklets, is packaged in a luggage-type carrying case. It may be purchased from General Electric for $100. Additional manuals and student booklets are available at nominal cost.

Course is designed to show how to select the right motor for any job. Specifically it instructs by showing how motors operate, what types are available, and how to select and apply the right motor from these types. The first three slide films in the course establish a common language at the start; *Fundamentals of Motors, Types of Motors, and Fundamentals of Motor Selection.* These are

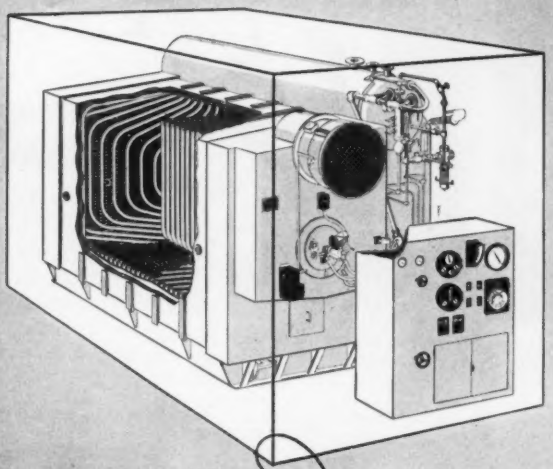
(*Continued on page* 206)

FOR MORE NEWS . . .

. . . of the power field, see the items on pages 206-214. Also, Coming Events for this issue appear on page 207; Appointments are on page 216.

get your steam

3,500 to 25,000 lb per hr



B&W Integral-Furnace Boiler, Type FM

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- unit

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- Low Maintenance
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- Suitable for Outdoor Service
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- Saves Space
- Safe, Automatic Operation

Send for Bulletin G-72, detailing the many advantages of this new B&W creation in low-cost steam generation. The Babcock & Wilcox Company, 85 Liberty Street, New York 6, N. Y.

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G-536

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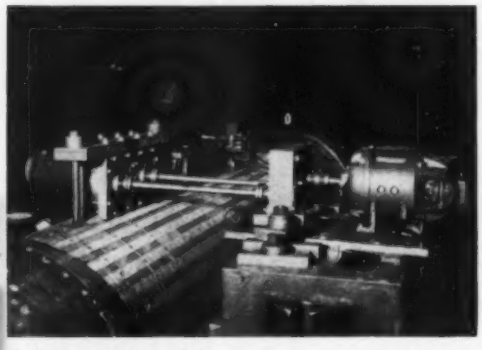
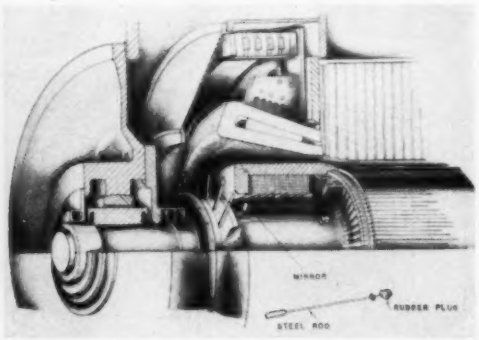
WATER TREATMENT
CORROSION
COOLING EQUIPMENT



1 This oscillator or shaker produces measurable test vibrations in generator rotors weighing more than 100,000 lb



2 Method of installing thermal balance plugs in rotor vent ducts to produce compensating temperature gradient in rotor

Electric Generation

MODERN PRACTICE IN BALANCING LARGE TURBINE-GENERATOR ROTORS, *by C M Laffoon, A C Hagg, C H Janthey and P R Heller, Westinghouse Electric Corp.* Review of equipment and procedures currently used in shop and field balancing. The authors consider unbalance as that caused by geometrical errors, nonhomogeneity of materials, or distortion under operating conditions of speed and temperature. Purpose of balancing is to offset these imperfections by adjustment of rotor-mass distribution. General aim is to secure a sufficiently smooth-running rotor so only acceptably small periodic forces will be transmitted to the supporting bearings and foundation.

Usually unbalance is caused primarily by geometrical errors and nonhomogeneous materials. Adjustment breaks down to simply adding or subtracting material in selected planes along the rotor. Then final adjustment depends on adequate rotor seasoning under operating conditions of load and temperature so any shifts of rotor parts (for instance coils) are complete.

Two types of distortion can be distinguished: (1) dynamic — distortion caused by dynamic stresses and (2) static — distortion traced to nonrotational effects such as thermal or pressure stresses. Adjustment of number and location of balance planes is the primary consideration for control of dynamic distortion. Static distortion can often be satisfactorily compromised by correction of the mean distortion unbalance. Adjustment of rotor ventilation will often eliminate or reduce distortion that is a function of temperature rise. Correction of thermal distortion by this means is called thermal balancing.

The authors then review some of the steps and equipment the shop uses for balancing. Balancing and seasoning is performed in a rig that approximates characteristics of the assembled unit when on its final foundation. Drives consist of either geared dc motors, electronic speed-control drives, or direct-driven 2-pole motors capable of close speed regulation from zero to 4400 rpm.

In addition to the balancing rig a seasoning-heater box encases the rotor. This heater box will maintain temperature at 130 C by automatic thermal controls. Box consists of an insulated and heavily ribbed outer shell, space heaters and a thin inner baffle shell that directs air through the heaters and rotor body. At full speed the windage loss of large rotors is often enough to maintain the required rotor temperature.

An oscillator or shaker, Fig. 1, is also used to determine vibration characteristics. This is capable of operating up to 10,000 cpm and produces measurable vibrations in rotors weighing more than 100,000 lb.

The authors claim the wattmeter-type vibration-measuring equipment is best suited for most accurate and reliable determination of unbalance. In operation, a small 2-pole sine-wave generator is directly coupled to the rotor to be balanced. Then its output is connected to the current coil of the wattmeter. In addition, electromagnetic pickups are applied directly to the shafts. This setup permits a single operator to conveniently follow the vibration of a rotor through testing cycles of speed and temperature.

Another instrument suitable for shop and field measurement of total vibration is the direct-recording *vibrograph.* This instrument scribes the vibration form directly on a recording tape. Then by a low power microscope the amplitude can be determined from 0.0001 to 0.060 in. for frequencies of 10 to 25 cycles.

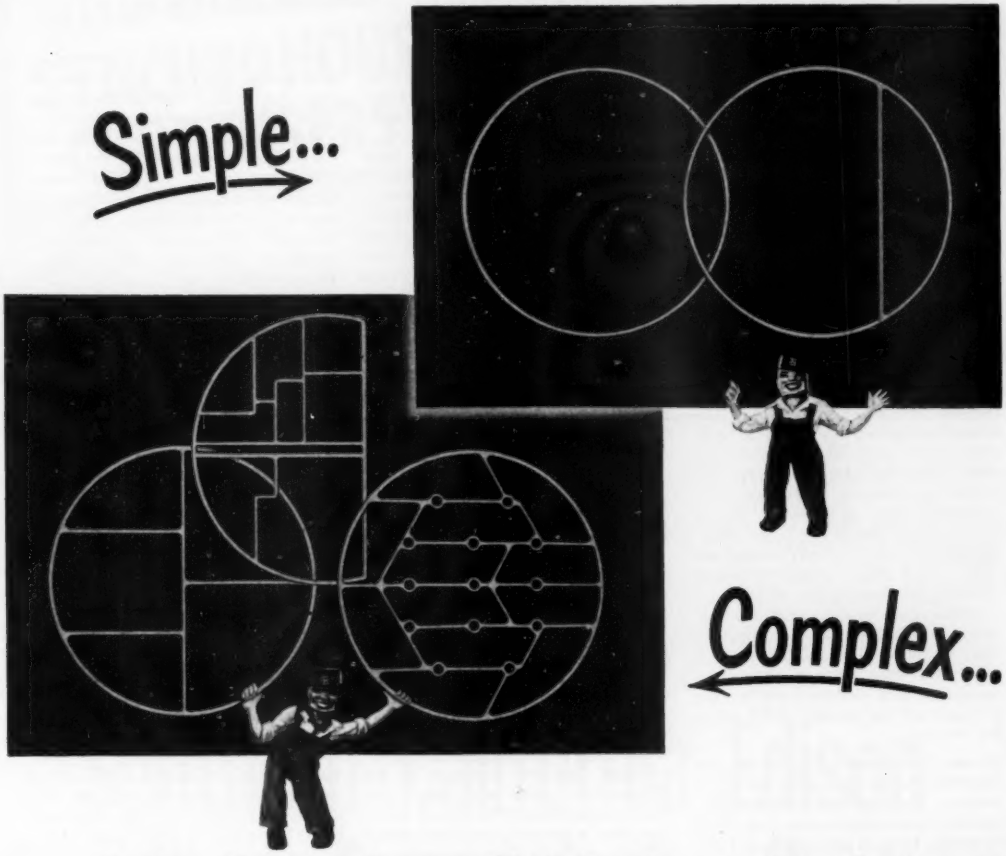
As part of the normal shop balancing procedure, the rotor is heated to a uniform temperature of 130 C. It is then balanced at its full operating speed of 3600 rpm. Rotor is seasoned for eight hours at full speed and normal temperature. It is then given a shakedown run at 110% normal speed.

After a final touch-up balance, rotor vibrations are checked in both hot and cold conditions to spot any tendency for thermal variations. With present-day equipment and techniques the normal

(*Continued on page* 156)

Directions for ordering papers are given on page 156

Precision-made to the design you need . . .



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balancing and seasoning period for large rotors is about five days.

Rotors are rechecked in the frame and given overspeed tests at 120% to demonstrate stability.

With the advent of the longer- and larger-diameter rotors, occasional cases are met where a change in balance occurs with rotor temperature. Normally these isolated cases arise from a slight bowing of the shaft such as might be produced by minor temperature variations across rotor's diameter or by differential expansion of several dissimilar materials.

If the observed change is small, it is possible to make a compromise mechanical balance. If the change is excessive, thermal balancing is used. And this means introducing a counter bowing by producing an artificial temperature gradient across the rotor's diameter. This is done by partly obstructing the axial ventilating ducts with special silicone rubber plugs. The plugs, ½ in. thick, are inserted under the overhanging end turns. Fig. 2 illustrates the method of inserting the plugs in the rotor.

Authors have included much information on production balancing along with other problems in vibration control. Generalized descriptions of the various equipments used are introduced in order to round out the picture. *AIEE paper No. 50-A-85.*

FUTURE ENGINEERING TRENDS IN THE ELECTRIC POWER INDUSTRY, *by A A Johnson, Westinghouse Electric Corp.* Installed generating power, now about 70 million kwhr, is expected to go to 93 million in 1953. Heavy load increases will continue, according to the author.

As a result of these load increases the various units going into the power plant are undergoing constant change. The building of units of higher ratings will continue as long as materials and design techniques follow their present advance. Reasons for this trend in ratings of individual units are as follows: (1) As load grows the maximum-size unit that can be applied economically grows with it. (2) Larger units cost less per kw of installed capacity. (3) Emergency conditions can be covered by area reserves. (4) Under emergency conditions, larger-size units will be favored because they take less critical material and manpower per kw.

An example of this trend is the fact that single-shaft units of 250,000 kva at 3600 rpm are now expected. Relation of size to weight in turbine-generator design has also undergone a marked change. In the larger sizes, the weight of 3600-rpm machines is now only about 60% of that for 1800-rpm machines. The gain in thermal efficiency for steam turbines with increasing temperatures and pressures is definitely leveling off.

The gas turbine, on the other hand, shows about three times the incremental gain in thermal efficiency with increasing temperatures. Its most efficient operation and, in fact, its future development depend on developing metals suitable for temperatures of 1500 F and higher. In the near future, capacities up to 10,000 kw in the open-cycle gas-turbine form will be seen. The closed cycle offers possibility of machines several times this rating. The industry is ready to build gas turbines up to about 15,000 kw with about the same efficiencies as the corresponding size of steam turbines.

The waterwheel generator is another story. Hydro generation in the U. S. now stands at about 18,000,000 kw. The ultimate capacity may reach 50,000,000 kw. Paper presented before the National Assn. of Purchasing Agents, Feb. 20, 1951. *Available through Westinghouse Electric Corp, Pittsburgh, Pa.*

Water Treatment

RELATION BETWEEN MUNICIPAL AND INDUSTRIAL WATER TREATMENT, *by J N Welsh, Hall Laboratories, Inc, Pittsburgh.* Since industry may be an important and profitable customer to the average waterworks, the author discusses the problems of the typical industrial plant in adapting municipal waters for industrial use. The waterworks can automatically benefit industry by employing procedures such as clarification and partial softening. But the author feels that perhaps additional softening, as an example, would be worthwhile.

Among the subjects the author discusses for consideration by the waterworks operator are suspended matter, organic coloring matter, hardness and carbon dioxide, ammonia, oxygen and phosphate. All these factors figure prominently in preparing water for industrial service.

The author discusses various methods of treating water for these factors and suggests preferred ones for the industrial water user. *Journal of American Water Works Assn, October 1950.*

PREVENTION OF CORROSION AND METAL ATTACK IN THE STEAM WATER CYCLE OF THE STEAM POWER PLANT, *by F G Straub and H G Ongman, University of Illinois, Urbana, Ill.* This paper primarily concerns itself with water in the pre-boiler cycle, the pickup of iron and copper soluble materials in this water, and the effect of these metals on the steel in the boiler. Results are given of studies conducted to determine the effect of pH in the cycle on the solubility of the metals.

Among the results reported is the effect of increasing the pH of the steam and feedwater by a controlled addition of ammonia to the cycle. In the author's opinion a pH of around 9 in the feedwater reduces the copper as well as the iron solubility to very low values. In addition, the action of reducing chemicals in the boiler beyond their normal action on free oxygen is also discussed.

One role of these chemicals seems to be that of lowering the activity of iron and copper entering the boiler so they do not come in contact with boiler metal until they have been reduced, and hence lessens their tendency to serve as potential oxygen carriers. *NACE paper No. 8.*

MERCURY BOILER TREATMENT WITH TITANIUM AND MAGNESIUM METALS, *by R C Reid, General Electric Co, Schenectady.* Adding titanium and magnesium metal to the circulating mercury of a boiler eliminates the mercury attack on boiler steel and maintains a wetting of the boiler surface that improves heat transfer. This paper discusses the mechanism of the dissolving action in a circulating mercury tube circuit. The various conditions brought about by the addition of magnesium are traced by means of the mercury-iron, mercury-titanium, and iron-titanium diagrams. The effects of oxygen in a mercury boiler system and the action of magnesi-

(*Continued on page* 188)

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from one of the following sources unless otherwise stated. Order complete paper from source—not from POWER.

American Society of Mechanical Engineers annual meeting, Statler Hotel, New York, Nov 26-Dec 1, 1950. Identified by initials and obtainable through ASME, 29 W 39th St, New York 18.

National Assn of Corrosion Engineers, annual meeting, Statler Hotel, New York, March 13-16, 1951. Identified by initials and obtainable through NACE, 29 W 39th St, New York 18, N. Y.

American Institute of Electrical Engineers, winter general meeting, Statler Hotel, New York, Jan. 22-26, 1951. Identified by initials and obtainable through AIEE, 29 W 39th St, New York 18

Southern California Edison Stabilizes Transmission System

With Allis-Chalmers Hydrogen-Cooled Synchronous Condenser

THIS 40,000/16,800 KVA HYDROGEN-COOLED SYNCHRONOUS CONDENSER supplies reactive kva to regulate voltage and stabilize the far-flung transmission lines of Southern California Edison. It is one of several similar Allis-Chalmers machines built and building for large power systems with relatively long transmission lines. All are custom built to fill system requirements and incorporate proven Allis-Chalmers features which assure long service life and low operating cost.

Whatever problem you may have in electrical power generation, distribution, control or regulation, your Allis-Chalmers representative can help you. For further information on Allis-Chalmers synchronous condensers, write Allis-Chalmers, Milwaukee 1, Wis., and ask for Bulletin 05B7285. A-3345

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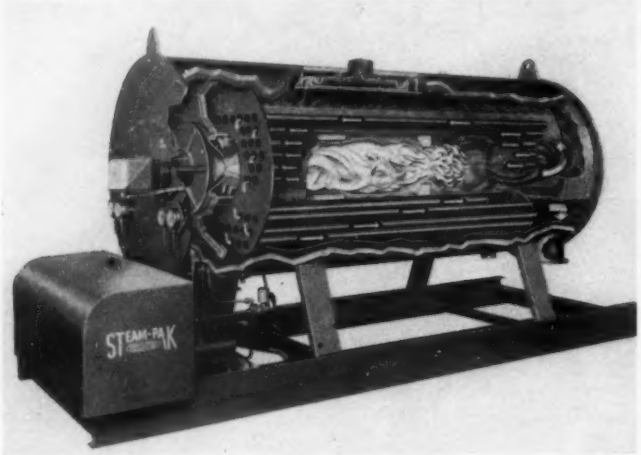
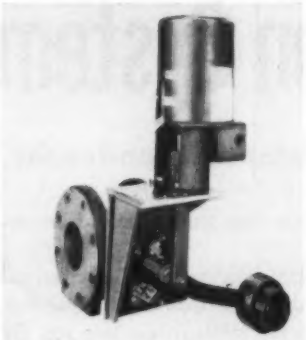


PACKAGED BOILER P523

New combustion chamber design features 1951 line of manufacturer's *Steam-Pak* packaged steam generators firing gas, oil or a combination of gas and oil. Models range in capacities from 600 to 10,000 lb of steam per hr. Burner admits the combustion material and burning air in a swirling fashion so it moves through the combustion chamber under highly turbulent conditions. At the center a factory-adjusted carborundum spring regulates the length of the circulating flame and controls excess-air mixing.

York-Shipley, Inc, 89 Jessop Place, York, Pa.



EMERGENCY-SERVICE VALVE P526

Heavy-duty rubber-seated cast-iron valve No. 763 has been developed for emergency gas or liquid shutoff service. Valve design and construction permit use of iron body in service that normally calls for stainless steel or other alloy. Rubber flanges take the place of usual flange gaskets. Valve sizes range from 2 to 72 in.

Direct-connected motor-driven pump sealed in oil completely cycles and operates valve. Hydraulic pressure raises counterweight for open position. When full-open, operating motor is stopped by integral switch. While operator is energized, current consumption is a minimum. If current fails, counterweight closes valve.

R-S Products Corp, 4600 Germantown Ave, Philadelphia 44, Pa.

LIQUID-HANDLING P518

Easy-pour tilter, GS No. 15, provides a safe and easy method of pouring highly acid or alkaline liquids from cans into small containers. It has a cradle of steel that fits any standard-size gallon can. All members are riveted or welded. It is ideal for making up different chemical mixes to be applied in small doses for various power-plant services.

General Scientific Equipment Co, 2700 W Huntingdon St, Phila. 32, Pa.

For more data on these items, use post cards, p167. Identify request with P and number.

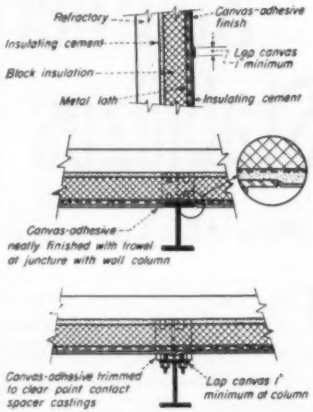
SPECIAL CANVAS FINISH ELIMINATES STEEL CASING

P500 Proper preparation and handling of canvas eliminates steel boiler casings. The advantages claimed are: (1) reduction of enclosure costs in both material and labor (2) improved air tightness (3) improved appearance (4) a weatherproof surface (5) a surface suitable for painting.

The problem of surface temperature, expansion and adhesion were the chief stumbling blocks in applying canvas for boiler enclosure. Under modern boiler design with regard to heat loss and surface temperature the proper amount of insulation gives a temperature gradient that brings the canvas temperature well under the range of 180-190 F surface temperature considered safe. Part of the answer has been development of a plasticized, synthetic, heat-resistant resin emulsion.

Further, this adhesive has enough elasticity to overcome the most extreme expansion problems such as those encountered with tube-supported enclosures. The recommended practice is to apply the canvas while the boiler is operating.

Lastly the adhesive and canvas combine to cover any shrinkage cracks in the finish coat of insulating cement. In addition they seal against air leakage due to porosity of the insulation.



There are several methods for applying the canvas finish. Several suggestions advanced by the manufacturer are shown in the three drawings above. The top one, for applying small panels of canvas, shows how to lap adjoining sections. The center and lower drawings give suggestions on handling junctions with wall columns.

Bigelow Liptak Corp, Detroit 2, Mich.

(Continued on page 160)

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NEW 36-PAGE EDITION OF

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...a bigger, more helpful handbook for training maintenance workers

You asked for ¼ million copies of the last edition of Piping Pointers. You found it a big help in training beginners and refreshing veterans in your piping crews. The bigger and better edition is just out—changed in appearance but not in purpose. Crane again offers this booklet—to help keep your piping systems at peak efficiency.

Piping Pointers talks facts . . . not theory. Thoroughly covers the fundamentals of good, sound, everyday piping practices . . . in easy-to-grasp, nontechnical language. Its many "how-to-do-it" features are illustrated for easy understanding.

Mistakes in piping installation and maintenance cost more today. Piping Pointers can help your men avoid them. Just ask your Crane Representative for a copy.

PARTIAL INDEX TO PIPING POINTERS

HOW TO choose valves for every service . . . install valves . . . read reducing fittings . . . make up screwed joints . . . assemble flanged joints . . . make up solder joints . . . install pressure regulators . . . use vent and drain valves . . . avoid steam trap trouble . . . save on pipe joints and materials . . . handle piping tools.

plus THE CRANE VALVE SELECTION GUIDE

which saves time and effort in selecting valves for common piping services.

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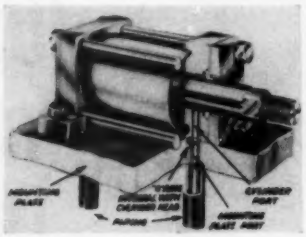
More EQUIPMENT NEWS

BLOCK INSULATION P527

Curved blocks of hydrous calcium silicate are now available for vessels up to 60-ft diameter. Curved blocks are nominally 18 in. wide; for vessels greater than 60-ft diameter, flat block is used. Material insulates effectively up to 1200 F, block thickness being 1 to 6 in. for flat-surface insulation. Addition of curved blocks to the *Kaylo* line makes available the most complete line of high-temperature insulation for pipes, tubes and tanks on the market, according to the manufacturer.

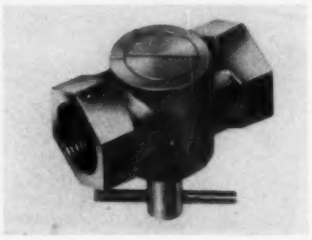
Owens-Illinois Glass Co, Kaylo Div, Box 1035, Toledo 1, Ohio.



AIR-CYLINDER MOUNTING P503

Quicker, easier installations of air and hydraulic cylinders with single or side-by-side manifold mounting requiring no pipe connections to the cylinders, is the prime advantage of the new O-ring cylinder mounting. With this mounting the piping connects directly to a port in a machined flat-surface plate or manifold and the cylinders mount on this plate with their ports mating in perfect alignment. The O-ring seals, at the mating surfaces of the cylinder port, assure a leakproof seal.

Miller Motor Co, 4027 N Kedzie Ave, Chicago 18, Ill.



FLOW-REGULATING VALVE P525

Stopcock is designed for use where an exact setting of regulated flow of water or other liquids is needed. Used as a flow-regulating valve for jet and spray pumps, as a bypass on boiler-feed lines, or any place where a quick-opening easy-operating flow-regulating valve or stopcock is needed. Features include finger-tip operation, ¼ turn for opening or closing, all-brass construction, O-ring packing and easy assembly. Available in ¾-in. pipe size with choice of two different-type plugs.

Reynolds-Shaffer Co, Dept G-58, 12100 Cloverdale Ave, Detroit 4, Mich.

DC-POWER SUPPLIES P553

Metal-enclosed dc power supplies utilizing selenium rectifier stacks. Applicable wherever dc power is required, the new conversion equipment may be used for excitation of synchronous motors; operation of dc elevators, cranes and machine tools; and for conversion of ac feeders to dc.

Designed for indoor installation, the rectifier units are mounted in a metal casing consisting of one to four separate sections, mounted vertically, one on top of the other, and bolted together. A removable-front, wire-mesh panel permits easy access to all component parts.

Units can be furnished to supply either 125- or 250-v dc from a 208-, 230-, or 460-v 3-phase, 60-cycle ac supply. Convection-cooled equipments are available in ratings of 0.75, 1.5, 3 and 5 kw. Fan-cooled units are rated at 7.5, 10, 12.5, 15, 18.5, 20 and 25 kw.

General Electric Co, Schenectady 5, N. Y.

CORROSION CONTROL P550

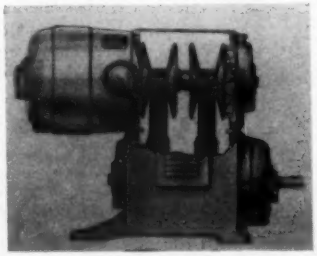
Nondrying black paste, *Tinallium Pro-Tex-It*, adaptable for metals, woods, and concrete-mixes for preservation against weathering, acids, fumes and chemicals, contains no lead oils, graphite, creosote or tar and is said to stop decay, rust or rot. To apply, you can use a brush while cold regardless of atmospheric conditions. Its temperature ranges from —75 F to +500 F. It is considered nontoxic and guaranteed harmless to mankind.

American Sand Banum Co, 9 Rockefeller Plaza, New York 20, N. Y.

PROTECTIVE COATING P505

Ceramic coating, *Elkote*, for metals and alloys provides a protective barrier against corrosion and oxidation at temperatures up to 2400 F. It adheres firmly to metals of widely different coefficients of expansion, even under flexing, percussion, vibrations, and sudden temperature changes.

Elraco Engineer Co, 158-14th St, Hoboken, N. J.



VARIABLE-SPEED UNIT P540

Heavy-duty motors for variable speed with ratings as high as 50 hp is part of the company's *Varidrive* line.

A calibrated spring maintains pressure between the two halves of the driven vari-disks and the sides of the belt. Spring takes up slack.

U.S. Electrical Motors, Inc, 200 E Slauson Ave, Los Angeles 54, Calif, or Milford, Conn.

For more data on these items, use post cards, p167. Identify request with P and number.

GLASS BLOCK P519

New water-repellent finish applied to exposed faces of light-directing glass block eliminates the need for strong acids to remove masonry deposits and other foreign materials from the glass-block surface when a building job is completed. The finish prevents adhesion of mortar to the faces during the laying operation, which means easier and faster cleaning.

American Structural Products Co, Owens-Illinois Glass Co, 409 Lexington Ave, New York, N. Y.

PLASTIC COATING P521

Air-drying, plastic protective coating protects tanks, tank cars, pipes, fittings, structural-steel parts against attack by splash, drip and spray from corrosive chemicals, atmospheres, and from weathering or rust. Plastic *U. S. Royalguard* combines high film flexibility with good adhesion and impact resistance. It can be used on steel, aluminum, concrete, hard wood or composition board, allowing one hour for drying between coats and 24-hr drying after final coat.

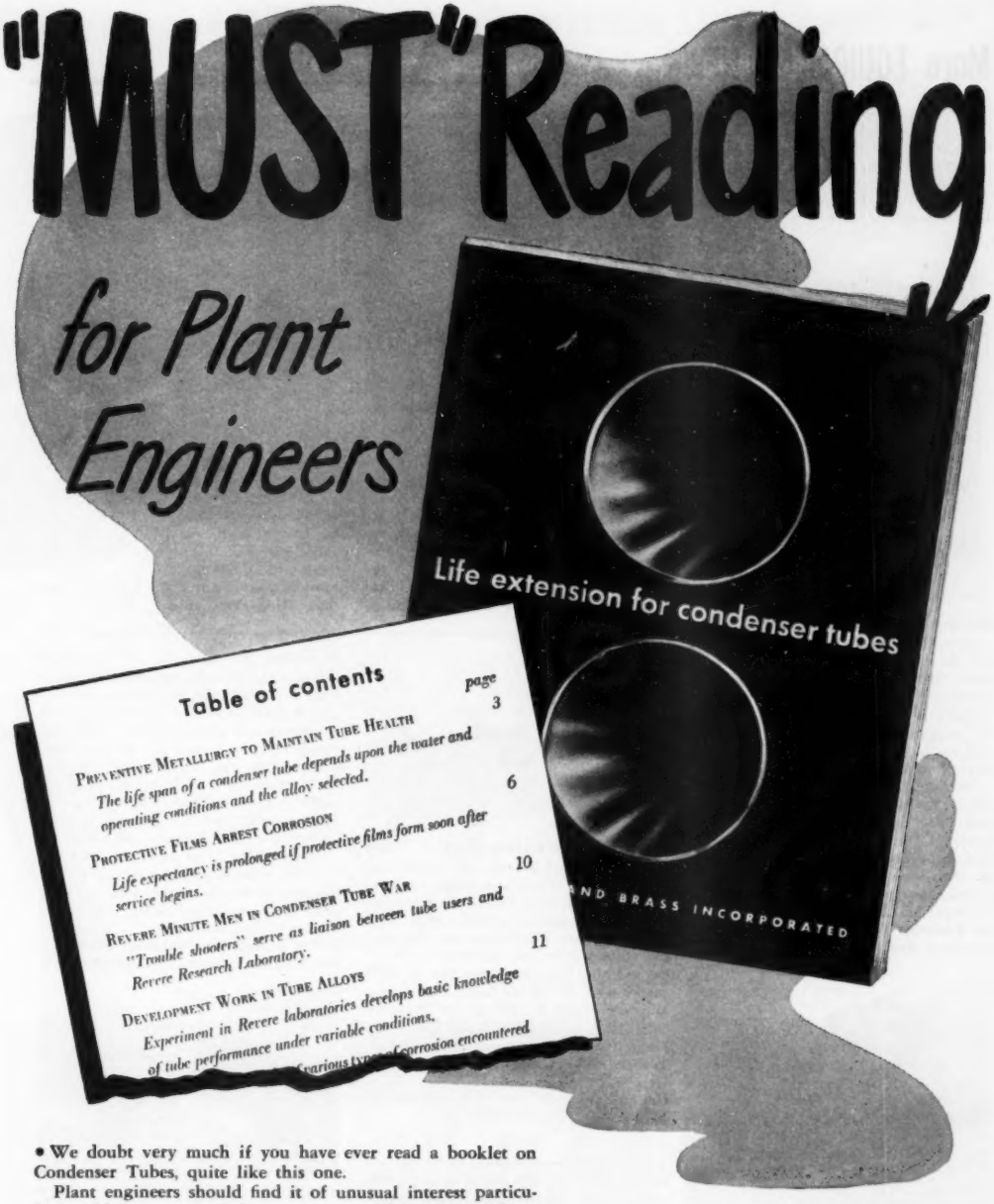
United States Rubber Co, Rockefeller Center, New York 20, N. Y.

ROUGH-SERVICE LAMP P538

A smaller, 100-watt rough-service lamp that fits standard wire-guard extension-cord equipment. Applicable to all types of rugged service, this lamp is particularly adaptable to use in shipyards and after-dark construction projects because it emits more light from a smaller, more breakage-resistant bulb.

Bulb is 2⅝ in. in diameter; ¼ in. less

"MUST" Reading for Plant Engineers


Life extension for condenser tubes
AND BRASS INCORPORATED
Table of contents
page
PREVENTIVE METALLURGY TO MAINTAIN TUBE HEALTH
The life span of a condenser tube depends upon the water and operating conditions and the alloy selected. 3
PROTECTIVE FILMS ARREST CORROSION
Life expectancy is prolonged if protective films form soon after service begins. 6
REVERE MINUTE MEN IN CONDENSER TUBE WAR
"Trouble shooters" serve as liaison between tube users and Revere Research Laboratory. 10
DEVELOPMENT WORK IN TUBE ALLOYS
Experiment in Revere laboratories develops basic knowledge of tube performance under variable conditions. 11

• We doubt very much if you have ever read a booklet on Condenser Tubes, quite like this one.

Plant engineers should find it of unusual interest particularly with present restrictions on copper and its alloys making it more important than ever that every last ounce of use be squeezed out of the condenser tubes in their plants.

This 28-page booklet includes data on various copper alloys, photos of cut-away tube sections showing various types of corrosion encountered in condenser tube service and photomicrographs showing the grain structure of different kinds of metals under varying operating conditions.

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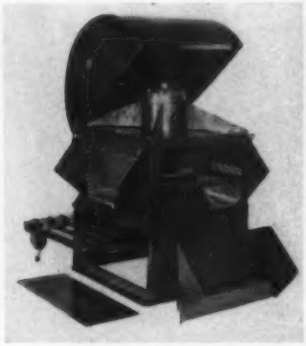
More EQUIPMENT NEWS

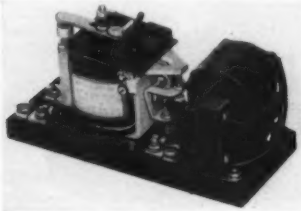
than the former A-23 bulb. With a maximum length of 5 5/16 in. from top of bulb to bottom of base, it is ¾ in. shorter than the A-23.
Westinghouse Electric Corp, Lamp Div, Bloomfield, N.J.



ROOF VENTILATORS P528

Type PRV power roof ventilator is suitable for commercial buildings, industrial plants, hospitals, schools and apartment buildings. Offered in 11 sizes, each size is available in two to four different speeds. For extra-quiet operation, low speeds are used in each of the 11 sizes. Pressures range from free air to 1½-in. static.

Centrifugal fan is directly connected to motor. Ventilation provided is positively controlled, independent of wind and weather conditions. The many features include self-cooled motor, weathertight housing containing complete fan unit and air control accessories, roof hinge on two sides for inspection and assembly.
Ilg Electric Ventilating Co, 2850 N Crawford Ave, Chicago, Ill.

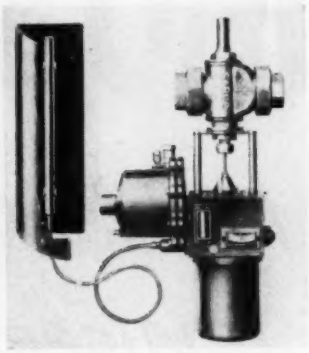


AC VOLTAGE RELAY P537

Bulletin 401 voltage-sensitive relays are intended for use in ac circuits where a close voltage differential between relay pick-up and drop-out is needed. Typical application is protecting ac motors up to 2 hp against damage caused by low line voltages. Other uses include power and lighting bus transfer and in some cases over-voltage protection.
Ward Leonard Electric Co, Mount Vernon, N.Y.

HEATING CONTROL P510

Weather-compensating control for steam-heating systems, the *Sarcostat* Type W, a fully modulating master control, fits on the main steam line or in each zone of the heating system. The outdoor-bulb temperature and steam pressure in the system combine to set the throttling position of the control valve. The outdoor bulb is liquid filled and acts to open the valve wider as the weather gets colder. Correctly sized orifice plates in the radiator or convector valve give even heat distribution during the throttling action.
Sarcotherm Controls, Inc, Empire State Bldg, New York 1, N. Y.



COMBUSTION SAFEGUARD P502

Commercial oil burners that require immediate cutoff of fuel in a failure can have this protection from company's new electronic combustion safeguard system. This includes a switch amplifier contactor unit, phototube holder, and electrode holder. If the gas pilot does not ignite, the oil valve cannot open. If the oil flame does not ignite, the supply of fuel is cut off. After cutoff, the motor operates 30 seconds to purge the nozzle or cup of unburned fuel. This prevents carbonizing and reduces field servicing.
General Electric Co, Schenectady 5, N. Y.

SULFIDE REMOVAL P508

Practical, low-cost removal of sulfides from industrial and domestic water supplies is possible with *Amberlite* IRA—410, a high-capacity anion-exchange resin. Necessary equipment need be no more complicated than the familiar water softener. If water hardness is high, softening and sulfide removal can be carried out together with no added cost for chemicals by using *Amberlite* 120, a strongly acid cation exchanger in the same unit with IRA-410. The new resin is an amine and is a high-capacity anion exchanger with a strong basic character that permits adsorbing weakly acidic constituents such as H_2S.
Rohm & Haas Co, Rosinous Prod Div, Washington Square, Philadelphia, Pa.

WINDOW VENTILATORS P529

Top-of-Window Ventilator uses variable-speed motor, draws in controlled quantity of outdoor air, distributes and diffuses air thoroughly before it reaches room occupants. Available in two sizes. At top speed one furnishes air for 8 people; other for 12.

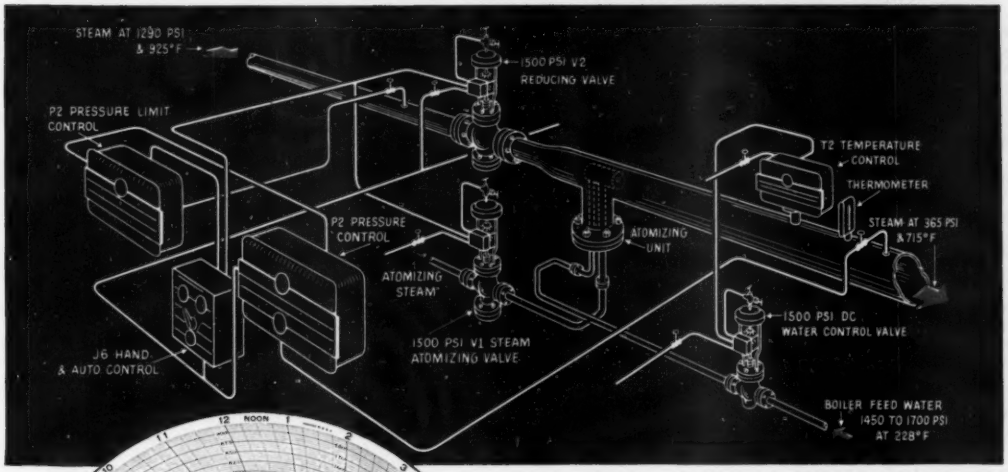
From fall to spring there are definite restrictions and basic objections to introducing fresh air at window-sill height. This ventilator produces a flat, horizontal trajectory of primary air with a set of upper blades. Lower blades give similar stream

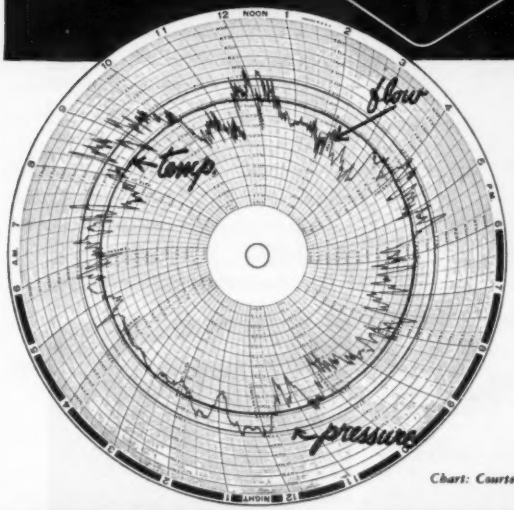
For more data on these items, use post cards, p167. Identify request with P and number.

And Next Month . . .

Fiberglas-reinforced polyester insulation stands up nicely at 125 C in a new explosion-proof mine motor. It even went a step further; a rough-and-tumble field test showed it could take it after 200 hrs at 150 c. An interesting step forward in electric motor insulation.

Swartwout RDC* controls within ±1 psi and ±3°F even with widely fluctuating load swings


STEAM AT 1290 PSI & 925°F
1500 PSI V2 REDUCING VALVE
P2 PRESSURE LIMIT CONTROL
T2 TEMPERATURE CONTROL
THERMOMETER
P2 PRESSURE CONTROL
ATOMIZING UNIT
STEAM AT 365 PSI & 715°F
ATOMIZING STEAM
1500 PSI V1 STEAM ATOMIZING VALVE
1500 PSI DC WATER CONTROL VALVE
J6 HAND & AUTO CONTROL
BOILER FEED WATER 1450 TO 1700 PSI AT 228°F

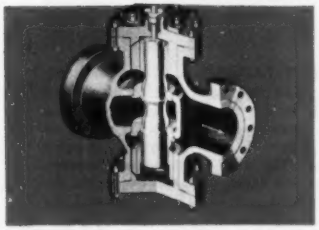


1 Chart shows how Swartwout RDC*—Reducing, Desuperheating and Control System—handles low-pressure turbine load of 65,000 to 165,000 lbs. steam per hour in Des Moines Power Station No. 2 of the Iowa Power and Light Company. It reduces from 1290 to 365 psi and desuperheats from 925° to 715°F. When main reducing valve closes, extremely light loads can be handled by pressure reducing valve supplying atomizing steam. Operation of the system is stable regardless of load change or time lag. Because of the exceptional control obtained by this large station, the Iowa Power and Light Company later purchased an additional small Swartwout RDC unit to supply steam to house turbines.

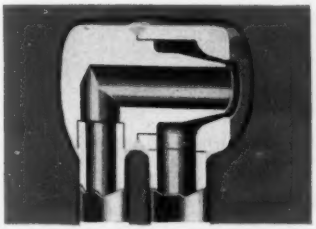
Swartwout

POWER PLANT EQUIPMENT

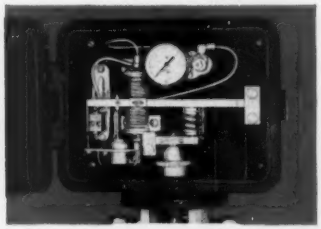
Chart: Courtesy Iowa Power and Light Company



2 Swartwout V-2 Regulating Valve has smooth, nozzle-shaped passages which guide expansion of high-pressure steam to reduced pressure zone without high-velocity impingement or other destructive forces common to conventional valves. Undue noise, turbulence and vibration are eliminated; longer valve life results.



3 Swartwout Steam Atomizing Desuperheater, constructed of stainless steel, has accurately machined passages that give narrow-angle dispersion of cooling water outside of steam atomizing head. There is no impingement of steam or water against walls of unit, no erosion of parts, no need for pipe liners.



4 Swartwout T-2 Control, with metallic temperature element in steam pipe, gives rapid and precise control regardless of magnitude of load or time lag. There are no flapper valves, relays or other delicate elements. Only two simple adjustments are involved; one for temperature, one for response.

A-5002

SEND FOR BULLETINS S-21-E, S-22-C, S-198 • THE SWARTWOUT COMPANY, 18511 EUCLID AVENUE, CLEVELAND 12, OHIO

More EQUIPMENT NEWS

of room air. Method utilizes waste heat, prevents stratification and permits use of fresh cold air for ventilation without danger of drafts. Window pole reverses unit for exhaust service.
E R Troxell, Jr, 4 Hathaway Rd, Bronxville, N. Y.

HUMIDITY CONTROL P522

Adsorption-type packaged humidity-control unit, Model 100, gives precise control over a wide range of temperatures from –40 to +100 F. It is considered ideal for cold-storage plants and unheated warehouses requiring year-round dry-cold protection. It measures 45 in. long x 19 high x 16 wide. It has a 3-channel continuous adsorption dehumidifier with plug-in automatic operation, and is effective singly in enclosed areas up to 25,000 cu ft. It operates from a 110-v 60-cycle single-phase power service.
Dryomatic Corp, 812 North Fairfax St, Alexandria, Va.

TEMPERATURE CONTROL P524

Calibrated dial, together with the Class T and Class M temperature regulators, gives a quick, easy and dependable temperature setting. A quick turn of the dial to the desired point is all the attention needed. Calibrated dial fits in place of a standard adjusting sleeve with no complicated linkages or gages to get out of order or add to the friction.
Leslie Co, 367 Delafield Ave, Lyndhurst, N. J.

STANDARD CELL P532

Electronic standard cell for industrial and laboratory use provides a dc reference voltage, stable to 0.25%. Output ripple on the low-current models is less than 0.01%.

Unit is for use with self-balancing potentiometers, wire strain gages, recording oscillographs, resistance thermometers, and other applications requiring a stable dc source.
Hastings Instrument Co, Inc, Hampton, Va.

STRIP-METAL CALCULATOR P552

Weight and length of strip metal in coils or straight lengths can be picked off the circular calculator at a glance.
Precision Steel Warehouse, Inc, 4401-25 W Kinzie St, Chicago 24, Ill.

HIGH-TEMP REACTORS P535

Glass insulation is now being used to increase life of cast-in-concrete reactors. This new insulation is capable of withstanding extremely high operating temperatures without deterioration and is completely unaffected by moisture. Unit is suitable for use in close quarters.
General Electric Co, Schenectady 5, N. Y.

PACKAGE HYDRAULIC SYSTEM P556

Combining compactness with adaptability this hydraulic system is for use by large and small plants. Solid coupling of motor and pump eliminates drive belts. More than 100 models offer ranges of 1.8 to 8.25 gpm and pressures up to 1000 psi. Totally enclosed motor is rated from 1/3 to 5 hp with manual, electropneumatic or hydraulic valve control.
Harco Industries, 20 Curtice St, Rochester 5, N. Y.

AIR FILTER P511

Impingement-strainer-type air filter uses a standard filter pad to which has been added a bonded industrial mat placed on the downstream side of the filter.
Glasfloss, 155 East 44th St, New York, N. Y.

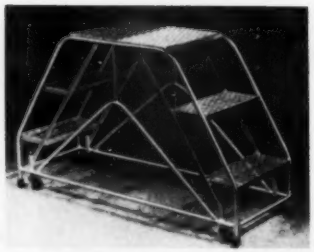
For more data on these items, use post cards, p167. Identify request with P and number.

Now Take Another Minute To Check These . . .

Hydraulic Filter with but three major parts. Designed for service on cooling waters of lathes, mills, bearings, etc. p 172
Comfort Thermostat operates on effective temperature. Suitable for hot-water and electric radiant heating .....p 172
Filter Cleaner for permanent-type elements in air-conditioning systems. One man can clean 600 normal filters in a day .....p 176
Pressure Switch operated by pressure drop from power or blower failure. May be used to start motors on automatic air equipment .....p 176
Conveyor Lubricator designed for automobile-body conveyers. All critical points of wear are reached automatically ....p 178
Radiation Detector weighs less than a pound and permits direct reading; unit's about the size of a quart oil can .....p 178

ELECTRIC HOISTS P555

Available in capacities from 250 to 1000 lb, these hoists have a shorter, deeper drum and so are lighter and better balanced than the Frame 1 design. They are well suited for hook suspension. As the highest capacity is 1000 lb these hoists use two parts of 3/16-in. cable, a smaller load hook and a smaller trolley. The hoists have shaved gears and the lower limit switch is standard equipment.
Wright Hoist Div of American Chain & Cable Co, Bridgeport 2, Conn.



SAFETY LADDER P551

Steps on both ends permit two or more people to use the ladder at one time on large assembly jobs. When no one is on the ladder it rolls easily on swiveled casters. The weight of a person, however, causes the spring-mounted casters to deflect so the legs engage the floor and the ladder will not roll.
Ballymore Co, 139 Pennsylvania Ave, Wayne, Pa.

CORROSION INHIBITOR P507

New inhibitor, *Santolene C*, for use in light petroleum products inhibits rust formation in lined vessels and storage tanks holding such materials as gasoline, kerosene and fuel oil. By following the proced-

(Continued on page 172)

ANNOUNCING A BRAND NEW CATALOG FOR BONNEY WELDOLETS

Contains complete and up-to-the-minute catalog information on all types of Weldolet welding fittings available. Presents a full range of sizes and schedules, introducing many new applications, together with simplified data on the determination of code requirements. To get your copy of this catalog, write . . .

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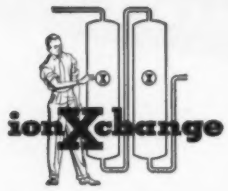


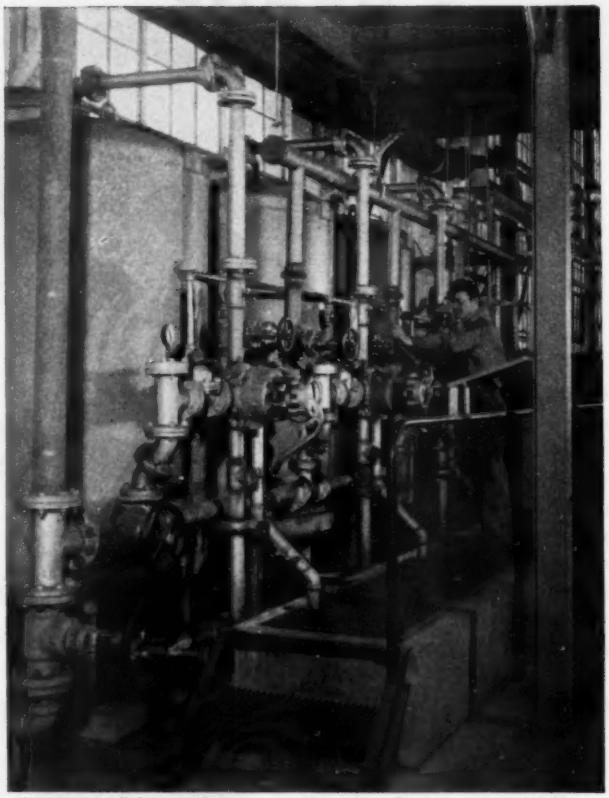
ILLCO-WAY's simplified modern boiler water conditioning system cuts steam costs, boosts efficiency at Caterpillar Tractor Co. plant

"Caterpillar" operates twelve 630 H. P. boilers on de-alkalized water. The boilers can be operated at 200% capacity, or at 1260 H. P.

Use of ILLCO-WAY equipment, shown at right, has reduced blow-downs by approximately one-half of former requirements. Continued use of de-alkalized water is expected to produce even greater blow-down reduction in the future.

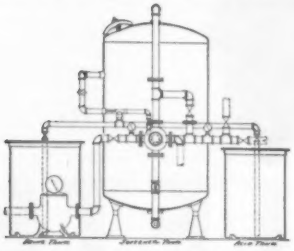
In nine months of operation the savings on make-up water have been very pronounced, Caterpillar reports. During normal operations, an estimated 100,000 gallons per day on make-up water are saved by using ILLCO-WAY equipment, as the result of elimination of excessive blow-down.

ILLCO-WAY De-alkalizing equipment produces water suitably low in alkalinity, reduced in solids content, free of hardness, at a cost comparable to softening. See Sweet's File, Engineering, or write us.



ILLCO-WAY De-alkalizing installation in power plant at Caterpillar Tractor Co., Peoria, Illinois

ILLCO-TEMP SOFTENER...for "zero" soft boiler feedwater without chemical after-treatment



Softener is easily added to hot lime-soda water softener. Unit operates economically and continuously at temperatures as high as 250° F or higher... c. i waters having a pH as high as 10.5.

This modern softener removes residual hardness from the effluent of hot or cold lime-soda units—*without chemical after-treatment.* Chemical savings from this alone will normally pay for equipment in less than 2 years. Reduction of effluent from lime-soda units to "zero" hardness produces real operating economies. Scale-forming salts are eliminated. No after-precipitation in the lines, pumps, pre-heaters, or the boilers themselves.

ILLCO-WAY

DE-IONIZING
DE-ALKALIZING
SOFTENING

ILLINOIS WATER TREATMENT CO., 853-5, Cedar Street, Rockford, Illinois • 141 East 44th St., New York City

Canadian Distributor: Pumps & Softeners Ltd., London, Ontario

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FREE CATALOGS AND BULLETINS

AIR CONDITIONING, HEATING REFRIGERATION AND VENTILATION

B1 **SPACE HEATERS** — Describes Dravo Counterflo direct-fired, warm-air space heaters in a range of gas- or oil-fired models with outputs from 400,00 to 2,000,000 Btu per hr. 8-page bulletin No. 536. Dravo Corp, Heating Dept, Fifth & Liberty Aves, Pittsburgh 22, Pa.

B2 **AIR CONDITIONING**—A planning guide for industrial air conditioning. Discusses five vital functions an air-conditioning system should perform and what to expect from an air-conditioning system. Illustrations, photographs, included. 36-page booklet No. B-5160. Westinghouse Electric Corp, Sturtevant Div, 200 Readville St, Hyde Park, Boston 36, Mass.

B3 **ELECTRONIC AIR CLEANER**—Describes the Precipitron electronic air cleaner. Explains how it operates; why it cleans air efficiently; where it can be used to advantage; how it is constructed; kind of unit to select. 8-page leaflet No. SA-6691. Westinghouse Electric Corp, Sturtevant Div, 200 Readville St, Hyde Park, Boston 36, Mass.

B4 **HEATING SYSTEMS** — Webster Tailmadge zoned controlled heating systems which provide complete heating requirements for hourly, daily and seasonal variations. Manual, full automatic or remote control. Complete description. 8-page bulletin No. WTS-750. Webster Tailmadge Systems, Div of Hoffman Specialty Co, Indianapolis 7, Ind.

BOILERS AND AUXILIARIES

B5 **TUBE-SUPPORTED WALLS** — Describes Bigelow-Liptak tube-supported walls for industrial boilers. Details how walls may be suspended directly from boiler tubes with resulting savings in steel and erection time. Engineering drawings, photographs. 12-page catalog. Bigelow-Liptak Corp, 3543 W Grand Blvd, Detroit 2, Mich.

B6 **COAL PREPARATION**—Features the Baughman Verti-Vane thermal coal dryer for economical, uniform and controlled large-scale drying operations. Assembly drawing included. 6-page bulletin, No. 101-A. Robert Holmes & Bros, Inc, 510-520 Junction Ave, Danville, Ill.

B7 **BOILER FEED CONTROL SYSTEMS**—Illustrates and describes three types of boiler feed control systems used in different plants of the Georgia Power Co. Bulletin No. 489. Northern Equipment Div, Continental Foundry & Machine Co, Erie 2, Pa.

B8 **BLOWERS** — Dimensional information on the Standardaire blowers including: engineering layout;

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application and design data; and rating. 6-page bulletin. Standard Stoker Co, Inc, 270 Lexington Ave, New York 17, N. Y.

B9 **PLASTIC REFRACTORY** — Ironton Nojoint, a modern plastic refractory, is described as ideal for rammed-in walls and baffles of boiler furnaces. Cross-section drawings show typical applications in hand-fired, stoker-fired and oil-fired boiler furnaces. 4-page bulletin No. 100. Ironton Fire Brick Co, Ironton, Ohio.

B10 **SPREADER STOKERS**—Data on Laclede universal spreader stokers including advantages and installations. 4-page bulletin No. 5110MB. Laclede Stoker Co, 4428 Hunt Ave, St Louis 10, Mo.

B11 **OIL BURNER** — Describes the Hauck long-nose-type low-pressure air atomizing oil burners for applications where the burner nozzle must extend into the furnace for some distance so that the flame will start farther away from the firing wall. Burns any grade of fuel oil. Sizes and dimensions. Form No. 412. Hauck Mfg Co, 124-136 Tenth St, Brooklyn 15, N. Y.

B12 **FIRE BRICK**—Presents economic advantages, industrial applications and refractory properties of JM-3000 insulating fire brick for sustained use at 3000F. Physical and thermal characteristics given in table form. 4-page bulletin. Johns-Manville, 22 E 40th St, New York 16, N. Y.

B13 **ASH-HANDLING SYSTEMS** — A discussion of Hydrojet ash-handling systems including basic arrangements and advantages; types for different furnaces and replacement installations; operating and construction advantages, disposal systems. 20-page brochure No. 751. Allen-Sherman-Hoff Co, 225 S 15th St, Philadelphia, Pa.

CONTROLS, ELECTRIC

B14 **FREQUENCY CONTROLS**—Illustrates and describes in detail all standard types of Polarized field frequency synchronous motor controls for full-voltage, reduced-voltage, and part-winding starting. Ratings, weights, dimension drawings, wiring diagrams, layout drawings, and specifications for each control given. 8-page bulletin No. 3100-PRD-204. Electric Machinery Mfg Co, Minneapolis 13, Minn.

B15 **AC RELAYS** — Information on power-type ac voltage sensitive relay including: features, application, description, operation principles, characteristics, contact ratings and dimensions. 2-page bulletin No. 401. Ward Leonard Electric Co, 31 South St, Mount Vernon, N. Y.

CONTROLS, MECHANICAL

B16 **TEMPERATURE CONTROL**—Describes the Wheelco Model 292 Capacitrol, a self-contained indicating deflection-type instrument for measurement and automatic control of temperatures on any type of heating equipment. Price list. 4-page bulletin No. 292-1. Wheelco Instruments Co, 847 W Harrison St, Chicago 7, Ill.

B17 **CENTRALIZED CONTROL**—Discusses new Multitrol control centers designed for accommodating any control system up to 600 volts, using components not larger than NEMA size 5. Types and specifications given. 4-page bulletin No. 4416. Ward Leonard Electric Co, 31 South St, Mount Vernon, N. Y.

B18 **COMBUSTION CONTROLS**—Latest information, description, specifications and photographs of Cleveland combustion instruments and controls. Also gives a full description of the new master regulator, the Model 9C-B steam control. 12-page catalog No. 5M51C512H Cleveland Fuel Equipment Co, 7316 Associate Ave, Cleveland 9, Ohio.

B19 **TEMPERATURE CONTROL** — Data on the Wheelco Capaciline, a supplementary straight-line control device which anticipates the fuel needs of controlled heating equipment. Form No. CL-1. Wheelco Instruments Co, 847 W Harrison St, Chicago 7, Ill.

ELECTRICAL EQUIPMENT

B20 **ELECTRICAL CONNECTORS** — Contains an illustrated listing of Burndy Hydent electrical connectors and installation tools for all industrial, manufacturing and aircraft use, with full instructions for their selection. 34-page catalog No. Y54. Burndy Engrg. Co, Inc, 107 Bruckner Blvd, New York 54, N. Y.

B21 **INSTRUMENT PANELBOARDS**—Gives data on Falstrom instrument panelboards. Designed in several sizes, with accessories for easy installation, they can be used singly or grouped for almost any type of installation. 4-page bulletin No. 143. Falstrom Co, 99 Falstrom Court, Passaic, N. J.

B22 **AUTOMATIC TRANSMISSIONS** — Two single-sheet forms. One describes Western 2-speed transmissions used to supplement constant-speed and multi-speed motors. The other describes the new Western 420 transmission including full engineering dimensions and specifications. Western Mfg Co, 3400 Scotten Ave, Detroit 10, Mich.

B23 **SYNCHRONOUS GENERATOR** — Bulletin, "Hydraulic Turbine-Driven Synchronous Generators and Large Vertical Motors," compares suspended and umbrella types of vertical generators. Shows advantages of enclosed construction using air-to-water heat exchangers. Also discusses horizontal generators. 32-page bulletin No. 05B7548. Allis-Chalmers Mfg Co, 953 S 70th St, Milwaukee, Wis.

HEAT EXCHANGERS

B24 **CONDENSER TUBES**—Brochure, entitled "Life Extension for Condenser Tubes," reports on long research done on causes of corrosion and means of combating them, as well as on the choice of condenser tube materials. Tables give estimating data for condenser and heat exchanger tubes in various alloys. 28 pages. Revere Copper & Brass Inc, 230 Park Ave, New York 17, N. Y.

B25 **STEAM-WATER DIFFUSER**—Illustrates and describes the new O'Brien all-bronze steam-water diffuser, designed for quiet mixing of steam and water to produce hot water. Diffuser also efficient for open-tank heating. 1-page catalog sheet. O'Brien Steam Specialty Co, Inc, 398 Heffernan Bldg, Syracuse 2, N. Y.

B26 **HEAT TRANSFER EQUIPMENT** —Shows representative items of the Patterson-Kelley line of heat transfer equipment, blenders and process vessels such as kettles, mixers, autoclaves, etc. 4-page catalog No. 10. Patterson-Kelley Co, Inc, 108 Warren St, East Stroudsburg, Pa.

MAINTENANCE AND SAFETY EQUIPMENT

B27 **OIL PURIFICATION** — Answers all questions about oil purification for hydraulic equipment, metal-working machines, gas and diesel engines, turbines, etc. 16-page booklet, entitled "Facts About Clean Oil." Honan-Crane Corp, 200 Superior Ave, Lebanon, Ind.

(Continued on page 226)

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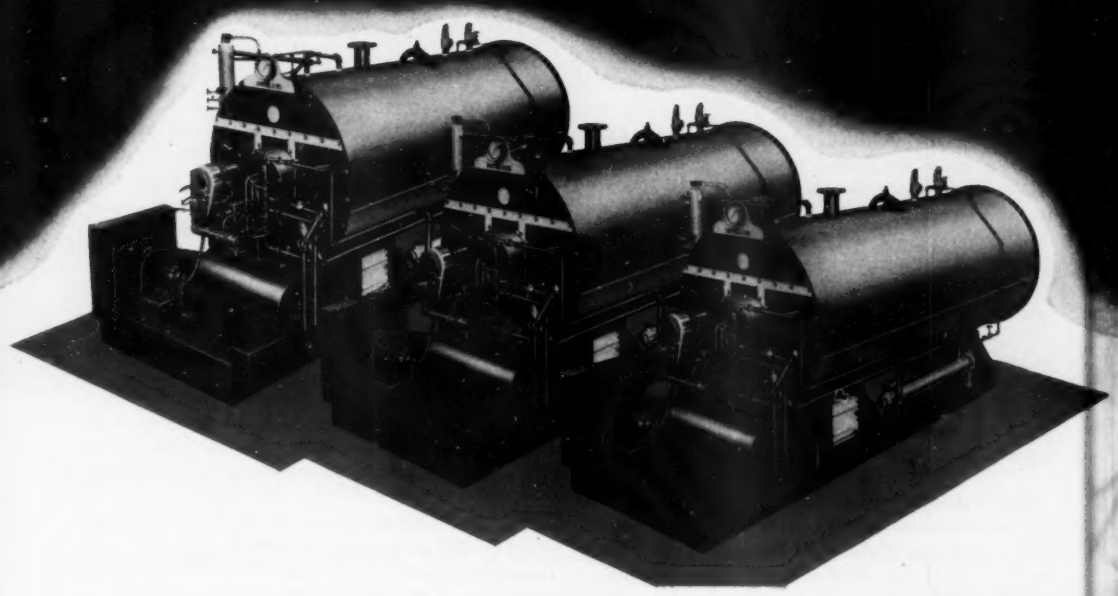
WHEN YOU'RE COUNTING

Superior STEAM GENERATOR



Battery installations of Superior Steam Generators provide extreme flexibility to meet the most widely fluctuating steam demands. A hospital installation illustrates the point.

From early June through September, steam demand is limited to the needs of hot water and sterilization. Any one of the three units carries this load with ease . . . and at higher efficiency than could be obtained by minimum operation of a larger boiler.

When cold weather adds its heating load, a second Superior Steam Generator is fired. Only the most severe weather demands firing the third unit . . . which throughout the rest of the year provides stand-by equipment which is desirable in any operation.

By employing different combinations of the three, (7 in all) allowing each unit in turn to share the load; all enjoy longer life at maximum efficiency . . . and by using only the number dictated by the steam demand, maximum economy at every stage of steam demand is assured.

Let us show you how battery installation can serve you better in your new plant . . . or augment your present steam facilities.

Write today for Catalog ***301***

Superior Combustion Industries, inc.

Factory Emmaus, Pa.

Executive Offices Times Tower, Times Square, New York 18, N. Y.

Easy Does It...

. . . Sure, that's just another one of those corny-sounding universal truths that's been quoted so often we've forgotten what it means. But every once in awhile it shows up when we least expect it.

Take, for instance, this piece I'm writing right now. You probably won't believe me when I tell you, but I've been trying off and on for five days to write this without success. During this time, I've been racking my brains to say something new to you fellow engineers. But I couldn't think of anything new to say. Are there any new ways to supervise a power plant, or any other kind of a plant, that someone else hasn't done before, or written about before?

Then I thought I'd look back over the other "essays" I've written in the past 15 years. Maybe a backward glance would suggest a new idea. But nothing seemed right for this time of year. Time of year . . . time of year . . . that was it. This is the time of year for spring house cleaning. I would write an immortal essay on spring house cleaning.

So I pulled open a desk drawer to find a pencil. But one look at the unholy mess in the drawer told me that any words I would write on house cleaning would be strictly those of a hypocrite. (However, as soon as I finish cleaning out my desk and files, you can expect something on spring house cleaning.)

A good many attempts later I still hadn't written this piece. Tonight I was determined to stay with it until I wrote it, or call up Phil Swain and ask his help in solving my problem. I had just about reached that point when I picked up the paper and read about the circus mule in New York City who pulled a sit-down strike in the middle of the parade from the freight yards to Madison Square Garden and had to be literally packed into a large taxicab and delivered in style.

That reminded me of the story about the young boy who was driving a mule down a country road when the mule just stopped and refused to move. The boy coaxed, yelled, pushed, pulled, kicked, whipped, all to no avail. Finally the boy gave up and lay down beside the road to rest, whereupon the mule got up and was ready to proceed.

How often in life we try just too darn hard. Sometimes we try to solve our problems by sheer strength—sheer will power, only to find it doesn't work. Then when we ease up a bit, many of our problems just seem to evaporate.

Look at me, I've practically finished this piece, with scarcely any trouble at all, since I stopped trying so hard. My prose isn't immortal but I think you get the point.

We engineers learn "Easy Does It" very early in life, as far as machinery goes. You can't force-fit the parts of an engine together and expect the thing to run. Yet how many of us try to force-fit ourselves or others, time after time, before we discover that "Easy Does It" applies to practically anything.

George Edwards

Engineer

DOWELL SERVICE

CHEMISTRY APPLIED TO MAINTENANCE CLEANING PROBLEMS

A Power Company asked: "Can you help us stop tube failures?"

Dowell Service provided a fast, effective solution!

A midwestern power and light company, operating 350,000 lb. per hour steam generators, was having numerous unscheduled shutdowns because of tube failures. Although tubes were turbined periodically and inspections showed that deposits were small in amount, tubes continued to blister. A crisis was reached when 11 outages occurred in 18 days!

Dowell Service provided the answer with a *more effective, faster and more economical* method of maintenance cleaning. Tube failures at this power house have been practically eliminated. A regular cleaning schedule using Dowell Service has solved similar problems in many other plants.

What is Dowell Service? Experienced engineers fill the equipment to be cleaned with special liquid solvents designed to dissolve and disintegrate the profit-stealing deposits from all surfaces, even the most complex, *in a few hours.* The solvents are carried to the job in Dowell pump trucks and are pumped into the unit through regular connections. There is no dismantling.

Call Dowell for consultation on your cleaning problems. A Dowell engineer is as near as your telephone. No obligation, of course.

Other recent Dowell jobs:

Anthracite filters cleaned by Dowell Service in one working day. Backwash rate increased from 75 to 385 g.p.m.

★

Five air conditioning compressors cleaned for office building in 8 hours by Dowell Service. Result: $15.70 per day saved on power demand.

★

Two 40,000 lb./hr. boilers cleaned for paper company in 24 hours. Result: 37 tons of fuel per day saved under same load conditions.

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ROTOJET

TUBE CLEANERS

Give you more

POWER, SPEED

DURABILITY

★ Rotojet Tube Cleaners, from head to hose, are tailored to meet individual requirements.

★ Roto Swing-frame Heads, pioneered by us, are the most durable and efficient for finish cleaning. A wide variety of heads and brushes with individually replaceable wearing parts reduce costs materially.

★ Roto Universal Joints combine strength with special protection against wear and vibration.

★ Rotojet Motors operate with air, steam or water. They clean tubes ½" ID up to large pipes faster than any cleaner we ever made. The rugged, efficient Rotojet Motor has only two moving parts.

★ Special Roto Operating Hose withstands abusive twisting, pulling, and abrasion.

★ From head to hose Rotojet gives you the best combination for a fast, thorough job.

SEND FOR NEW ROTOJET BULLETIN

ROTOJET Water-driven Motor Model 321 with swing-frame head and universal joint for 2½"-3" I.D. curved tubes.

ELLIOTT COMPANY-ROTO DIVISION

153 Sussex Avenue Newark 1, N. J.

EQUIPMENT NEWS

(*Continued from page 164*)

ure of modified ASTM D 665—47 T (80 instead of 140 F) as little as 0.002% by weight of *Santolene C* is effective. Under extreme conditions, such as salt-water contamination or long-time static storage, greater concentrations, possibly as high as 0.01%, are used.
Monsanto Chemical Co, Organic Chemicals Div, St. Louis, Mo.

For more data on these items, use post cards, p 167. Identify request with P and number.

HYDRAULIC FILTER P554

Only three major parts—lower end plate and insert, combined supporting tube, upper end plate with threaded outlet sleeve—give extreme simplicity to new hydraulic filter recently announced by the manufacturer. The filter is built for service on cooling waters used on lathes, mills, planers, drills, bearings, and hydraulically-operated machines.
Dollinger Corp, 11 Center Park, Rochester 3, N. Y.

COMFORT THERMOSTAT P516

Surface-type *Thermoray* is a special comfort thermostat functioning according to effective temperature. It applies to hot-water radiant heating as well as to electric radiant-heating panels. The instrument can be used for line or low-voltage circuits and can be furnished with double switch action for any special control sequence required.
Sarcotherm Controls, Inc, Empire State Bldg, New York 1, N. Y.

PLUG-IN CIRCUIT BREAKER P536

Breaker for 15- to 50-amp service, featuring quick-make, quick-break operation and thermal-magnetic protection. Contacts are opened and closed with a fast, clean action, avoiding excessive burning or arcing of the contacts due to improper operation.

Breaker is tripped by either of two impulses. Thermal action of bimetal trip element responds to an overload condition, although harmless temporary overloads will

5 kv outdoor metal-clad switchgear with DZ 60 B oil circuit breakers rated 150 mva installed at an east coast utility.

WHEN INDOOR space becomes limited — go OUTDOORS where there's lots of room for future expansion. You save valuable indoor space for other equipment, eliminate expensive building additions or changes.

For outdoor service be sure the switchgear you select is completely steel enclosed to assure reliable operation in any weather—sleet, snow, rain, subzero temperatures and intense heat.

Allis-Chalmers Switchgear is All-Weather Protected: (1) welded-in steel floor plates form a tight bottom seal; (2) overhanging eaves keep out driving rain and sleet; (3) weather proof doors, 3-point latched, close firmly; (4) steel surfaces are phosphate treated prior to receiving multiple coats of weather-tested paint that makes them corrosion and weather resistant; (5) structure rests on 6" base channels; (6) ice and sleet guards protect locks; (7) copper mesh filters furnish protected ventilation.

Allis-Chalmers 5 kv and 15 kv outdoor switchgear is available in ratings from 600 to 2000 amperes, 50,000 to 500,000 kva interrupting capacities. Consult your nearest A-C sales office.

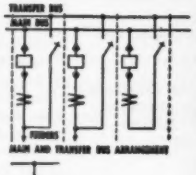
Allis-Chalmers
Milwaukee 1, Wis.

ALLIS-CHALMERS

A-3033

VARIED CIRCUIT ARRANGEMENTS

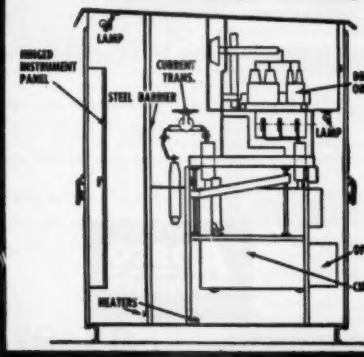
Unique compartment design permits many circuit arrangements in a standard breaker unit. Two typical arrangements are shown:



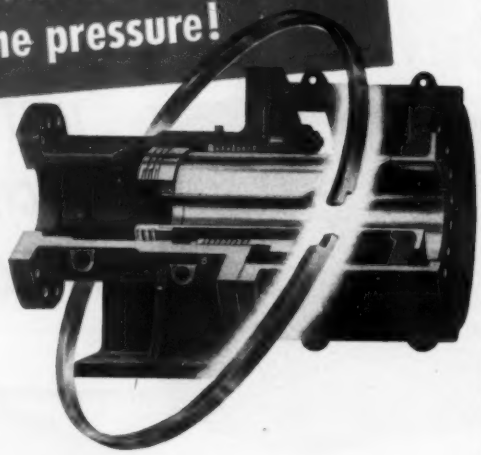
1. Double bus arrangement with transfer bus and disconnect switch above the main bus compartment. All equipment is easy to get to without extra provisions.

2. Control power transformer arrangement that eliminates the need for an extra auxiliary compartment. Generally used for secondary control battery charging and to supply power for space heaters and lighting applications.

CONSTRUCTION DETAILS



Pack this ADSCO joint at full line pressure!



Special Piston Rings HOLD line pressure during packing operations

Production is reaching for an all-time high. Costly service interruptions and resulting operational losses must be eliminated! One major cause of down time... cutting off service to repack pipe line expansion joints... *can* be completely eliminated. ADSCO Piston-Ring Expansion Joints can be packed *under full line pressure* with no interruption of service.

ADSCO's patented piston-ring feature... with combined internal guide... holds the line pressure even when the packing is completely removed. Venting the relief chamber exhausts any accumulated steam that may have passed the rings and, with no pressure against the stuffing box, all packing may be withdrawn.

Get these ADSCO extra features

NO SCORING OF SLIP because it is in contact only with the packing. The piston rings ride the machined bore of the body.

COMPLETE GUIDING both internally and externally to prevent misalignment.

SPLIT EXTERNAL GUIDE permits installation in smaller spaces.

LIMIT STOPS prevent over-travel. The slip cannot be pulled from the body while in operation.

PACKING LUBRICATION is provided to prolong packing life and ensure smooth performance of the slip.

NON-FREEZING GLAND STUDS AND BOLTS are of non-corrosive metal and always accessible through special openings in the external guide.

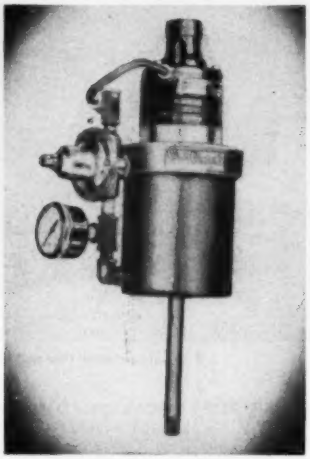
ADSCO Piston-Ring Expansion Joints are available in a full range of sizes, in both single and double units, with 4", 8" or 12" traverse per slip, for pressures to 400 psi and greater, and for temperatures to 750 F. and higher. For information, see your ADSCO representative or *write for Bulletin No. Z-35-15.*

AMERICAN DISTRICT STEAM COMPANY, INC. ★ North Tonawanda, N.Y.

be passed without opening the circuit. Magnetic action instantly opens the breaker in a short circuit. Unit is designed for use in a new line of load centers and panelboards.

Trumbull Electric Mfg Co, Plainville, Conn.

For more data on these items, use post cards, p 167. Identify request with P and number.



PNEUMATIC CYLINDER P512

Cast-aluminum bucket-type cylinder, the B-50, is a new design of "Q"-ring-sealed pneumatic cylinder with a piston positioner mounted in the head plate. This ring provides a perfect seal with minimum friction. The positioner mounts on the head plate and takes its position by means of a contact spring riding on the piston. Cylinders are suitable for use with air-supply pressures up to 100 psig with repositioning accuracy to 1/500th part of the total travel. Series available in 4-, 6- and 8-in. bores and strokes up to 4 in.

Conoflow Corp, 2100 Arch St, Philadelphia 3, Pa.

PROTECTIVE PAINT P514

Addition of silicones to *Chem-Rem* acid and alkali-resisting black paint is said to improve paint luster and provide smoother coverage with greater acid resistance, plus increased water repellence. *Chem-Rem* is suitable for both interior and exterior use on metal, masonry or wood. It can be applied by brush, spray or dip method. Its finish dries to the touch in one hour and sets in three.

Speco, Inc, 7308 Associate Ave, Cleveland 9, Ohio.

WELDING ROD P517

Cast iron, general-purpose welding and brazing rod, All-State No. 3. Copper-coated to prevent rusting and improve flow characteristics, it gives a weld with tensile strength up to 48,000 psi, a Brinell hardness of 170-200, and under a working tem-

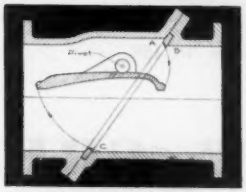
Stop Expensive Slamming With the Cushioned Closing of CHAPMAN TILTING DISC Check Valves

Those words — *cushioned closing* — best describe the action of this unique check valve. The tilting disc works with the stream—opens easily, closes quickly, *yet quietly.* There's no slamming — no resultant destructive stresses on the pipeline.

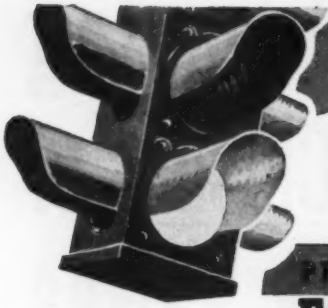
As a result of this smooth, *cushioned action,* maintenance costs are at a minimum and savings of from 65% to 80% in head losses can be obtained over conventional-type check valves.

Send today for the bulletin describing this unusual valve.

THE CHAPMAN VALVE MFG. CO.
INDIAN ORCHARD, MASSACHUSETTS



Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

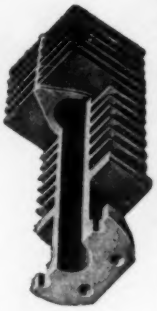


GREEN

PREMIER DIAMOND

ECONOMIZERS

Good Parts are Essential to a Good Machine . . . Let's examine a Green Fuel Economizer—Type 25—and study the major parts.



FINNED CAST ALLOY IRON TUBES WITH DIAMOND SHAPED SECTION

The diamond shape provides less restricted gas flow; easy cleaning and clearview inspection. The fins provide maximum heating surface in given space.

SEPARATE SUPPORTING AND JOINTING FLANGES

Supporting flange is separate from and independent of jointing flange. Jointing flange is not exposed to hot gases. Through bolts rather than studs are used to connect jointing flanges.

CORRECTLY PROPORTIONED, STRONG CONNECTION BENDS

These are designed to provide needed flexibility with strength. Flanges on tubes, bends and manifolds are accurately machined.

Green specially designed Soot Blower assures thorough cleaning.

Green Type 12 Premier Diamond Economizers—the Steel Tube Units—are made up of equally strong and well designed parts. Send for Bulletin No. 169.

THE GREEN *Fuel Economizer* COMPANY INC.

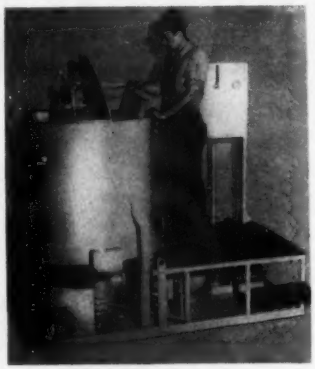
BEACON 3, NEW YORK

ECONOMIZERS • FANS • AIR HEATERS • CINDERTRAPS

perature of 1400 to 1500 F. Rod is applied with No. 1 cast-iron flux and a neutral oxy-acetylene flame. It does not require melting of base metal or "puddling the weld." Large castings require preheating to about 800 F.

All-State Welding Alloys Co, Inc, 273 Ferris Ave, White Plains, N. Y.

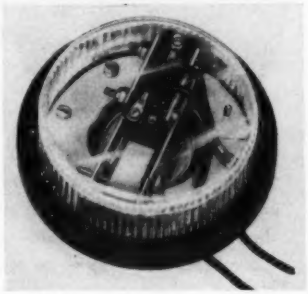
For more data on these items, use post cards, p 167. Identify request with P and number.



FILTER CLEANER **P520**

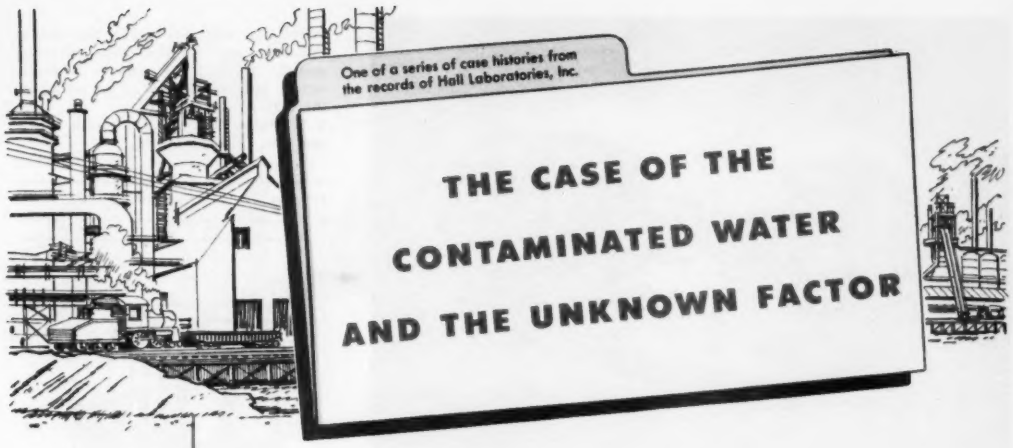
Permanent-type filter elements used in air-conditioning systems can be cleaned at faster speed with less work by using the *Safe-N-Ezy* air-filter washer-oiler. One man working at normal speed can clean 600 or more 19½x19½x2⅛-in. air filters in an 8-hr day. Filters in an interior basket of a washer spin under centrifugal force throughout a complete screening cycle where they are rinsed, spun dry and oiled all in one continuous operation.

Paxton-Mitchell Co, Omaha, Neb.



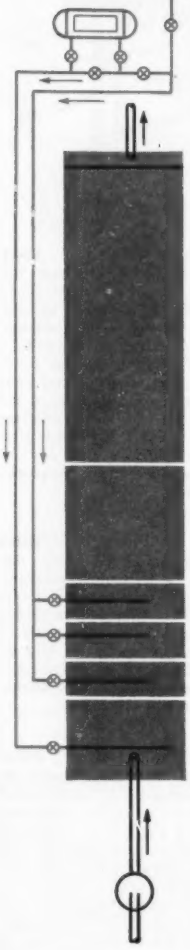
PRESSURE SWITCH **P509**

Pressure drop in air filters, across coils, or resulting from power or blower failure, may be used to set in motion a pressure-actuated switch for actuating motors on automatic air equipment or for similar service. Pressure changes are reflected in the movement of a beryllium copper spring with a high-sensitivity micro switch. Switch comes in two models. No. 1620 has a 4½-in. dia and a minimum setting of 0.25 in. of water with a gap between make-and-break pressure of 0.120 in., or greater. The second



One of a series of case histories from the records of Hall Laboratories, Inc.

THE CASE OF THE CONTAMINATED WATER AND THE UNKNOWN FACTOR



Waste water in this industrial plant was contaminated by certain solids and phenol and cyanide. Concentrations of these materials were too great to permit discharge into the river without treatment.

The alternatives were:

1. Treat to reduce phenol and cyanide to permissible concentrations, and discharge into the river.

2. Treat for re-use in the plant, using up the excess for evaporative cooling.

Obviously, the decision would have to be based on relative costs of the two procedures, but there was one unknown factor —the cost of treatment for removing the phenol. Methods were known, but no cost figures were available.

Hall engineers designed an inexpensive pilot plant, and a few weeks' operation of this plant gave the missing information, permitting an accurate comparison of costs. The water re-use procedure was adopted —and the saving to the plant is approximately $20,000 a year.

Hall Laboratories is prepared to study *your* water problem, and to suggest procedures which represent the most efficient and economic solution *in your specific situation.* For more information, just clip and mail the coupon.

HALL LABORATORIES, INC.

(A SUBSIDIARY OF HAGAN CORPORATION)

CONSULTANTS ON BOILER WATER CONDITIONING;

PROCUREMENT, TREATMENT, USAGE AND DISPOSAL OF INDUSTRIAL WATER

Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa. P-5

Please send me your bulletin, "Let's Consider Your *Whole* Water Problem."

Name_____

Position_____

Company_____

Street & Number_____

City_____ Zone_____ State_____

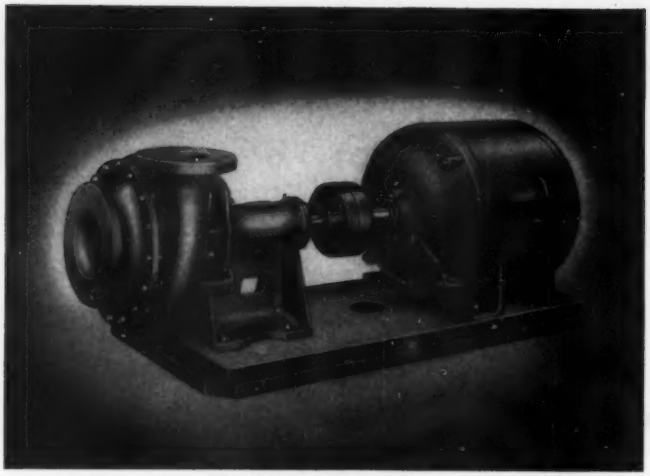


Fig. 3169 single stage, open impeller centrifugal

Goulds *New Design*

gives carefree pumping efficiency for the long pull

The 3169 is one of the latest designs to come off Goulds drawing board. It takes every advantage of modern hydraulic design—and it is thoroughly tested and proven for economy and dependability.

With the 3169 you get tremendous versatility with high operating efficiency and relatively low power consumption.

REAL "JACK-OF-ALL-TRADES" ADAPTABILITY

This new pump will fit many applications—water service, irrigation, slurries, circulation, transfer, factory wastes, air conditioning service, plumbing, heating, and many others. If you face conversion, this adaptability is a double value.

TEN SIZES TO FIT YOUR NEEDS

Available in ten sizes for both motor and belt drives. Capacities up to 1080 G.P.M.—with heads to 290 ft. depending upon capacity.

For complete information phone or write Pump Headquarters, Seneca Falls, N. Y. Ask for Bulletin 720.4.

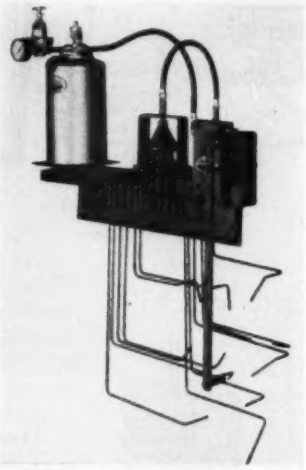
MEMBER

Goulds PUMPS INC. Seneca Falls New York

model, No. 1625, has a 7-in dia with a minimum gap between make-and-break pressure of 0.05 in. of water in the lower setting, and 10% or more of the setting in the higher ranges.

F W Dwyer Mfg Co, 317 South Western Ave, Chicago 12, Ill.

For more data on these items, use post cards, p 167. Identify request with P and number.



CONVEYOR LUBRICATOR P534

This automatic 12-point lubricator was especially designed for automobile body conveyors. All the critical points of wear are reached with this controlled lubrication that were formerly lubricated by hand.

The 2-gal reservoir, sufficient for a two weeks' supply, is equipped with air regulator and pressure gages, as well as the necessary manifolds, flexible connections and nozzles required to deliver oil to vital points.

J N Fauver Co, Inc, 49 W Hancock, Detroit 1, Mich.

ANTI-FOAM P504

Improved Dearborn formula No. 659 gives a product with unusual solubility characteristics, plus the advantages of oxygen-scavenging and sludge-conditioning agents. In addition, the product is said to inhibit aerosol formation in steam, thus reducing the prime cause of entrainment.

Dearborn Chemical Co, 310 S Michigan Ave, Chicago 4, Ill.

RADIATION DETECTOR P558

Atomic-radiation detector to permit direct radiation readings at a glance. Called a "radiation monitor," the new instrument weighs less than a pound and is about the size of a quart oilcan. It is equipped with a self-contained power source, and has neither tubes nor batteries.

Speed at which the pointer moves across the scale is in proportion to the strength of radiation, and the distance it moves in

We have been asked:

"What is the best insulation for process lines which must be taken down for occasional cleanings?"

An engineer writes—"We have several hundred feet of process lines which must be taken down every few months for cleaning. These lines operate at a temperature of about 500° F. Which kind of pipe insulation do you recommend for this type of service?"

In this case, we suggested Bestfelt insulation for the lines.

This highly efficient pipe insulation is constructed of built-up layers of crimped asbestos papers having approximately 33 layers per inch of insulation thickness. This construction gives Bestfelt covering unusual strength and high resistance to breakage when the process lines are occasionally taken down and cleaned.

This insulation also is an excellent material for fabrication of flange or other fitting covers which must be removed and replaced frequently. In addition, it will withstand vibration better than other types of insulation recommended for use in its temperature range.

Bestfelt can be wired in place over the line, then covered with rosin-sized paper and sewed or pasted canvas. The insulation need not be removed each time lengths of pipe are taken down for cleaning.

Helping you arrive at the most practical solution to any insulation problem is part of the day-to-day job of Armstrong engineers. The next time you're up against a problem call in one of these men. Just get in touch with the Armstrong office nearest you.

SEND US YOUR QUESTIONS: If you have any questions on the use or application of either high- or low-temperature insulation, please do not hesitate to write to us. We'll do our best to give you a prompt and practical answer. Just address a letter or post card to Armstrong Cork Company, 7005 Maple Street, Lancaster, Pennsylvania.

ARMSTRONG'S INDUSTRIAL INSULATIONS

MATERIALS - INSTALLATION

FOR ALL TEMPERATURES FROM 300°F. BELOW ZERO TO 2800°F.

TYPE 1 TYPE 1A

Single or double fan installations with automatic controls. Double operates on single furnace, or serves two. On single furnace either fan can operate up to 70 percent capacity; other fan then cuts in automatically.

TYPE 2

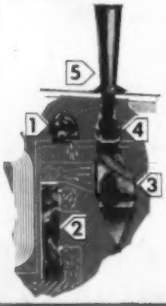
TYPE 2A

TYPE 3

You eliminate fluctuations or losses in draft efficiency by the use of Prat-Daniel Stacks. P-D Fan Stacks coordinate the relationship of fans, breeching and stacks to provide and maintain maximum efficiency.

Thousands of P-D Fan Stacks in long operation have proved their superior reliability over induced-draft fans and stacks purchased separately. Easily applied to any installation, they provide highly efficient draft for the load conditions of your power plant.

Our project engineers provide expert assistance on any problems of draft production and control. Call them on current problems or planned installations. Write for Catalog No. 200.



UNIT RESPONSIBILITY

Prat-Daniel, through its sales and project engineers, The Thermix Corp., offer a complete complement for handling the air gas stream shown at left; 1. Forced Draft Fans, 2. Air Pre-heaters, 3. Tubular Dust Collectors, 4. Induced Draft Fans and 5. Fan Stacks. This unit responsibility, by a well-known firm, relieves the engineer of the responsibility for one of the most important functions in a steam generating plant.

Sales and Project Engineers

THE THERMIX CORPORATION
GREENWICH, CONN.

Canadian Affiliates: T. C. CHOWN, LTD.
1440 St. Catherine St., W., Montreal 25, Quebec
50 Abell St., Toronto 3, Ontario

Designers and Manufacturers

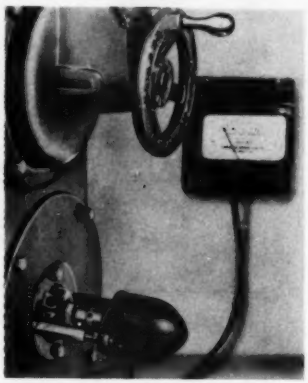
PRAT-DANIEL CORPORATION
SOUTH NORWALK, CONN.

a given time indicates the amount of radiation the instrument has been exposed to during that time.

Monitor is for use by engineers, scientists, doctors and technicians who are working with or near sources of radiation. They can warn of the presence of radiation in amounts much less than those permitted by even the most stringent safety regulations.

General Electric Co, Schenectady 5, N. Y.

For more data on these items, use post cards, p 167. Identify request with P and number.



ELECTRIC TACHOMETER P533

Device for use with this company's variable-speed transmission and varispeed motor drives, when they must be mounted in inaccessible or remote locations.

This electric tachometer, operating on ac generator principle, allows more flexibility in installation, since indicator may be mounted as far as 300 ft from the variable-speed drive.

Reeves Pulley Co, Columbus, Ind.

TIN SOLDER P501

Tin solder ST-30 (30% tin) performs as well as commonly used 50%tin—50% lead, or 40% tin—60% lead solder. Same fluxes apply as used before and methods of handling are identical. The ST solders require slightly more heat to melt, but too much heat is not as harmful as with the usual tin-lead solder.

Federated Metals Div, American Smelting & Refining Co, 120 Broadway, New York, N. Y.

CONTROL CENTER P530

Designed to accommodate any control system up to 600 volts, using components not larger than NEMA Size 5. Primary applications of *Multitrol* are for refrigeration and air-conditioning systems, industrial-plant machinery, generating-plant auxiliaries and similar installations where a group of motors can be independently controlled from a central location.

Prefabricated units containing control for a single motor are assembled and wired

less servicing... more service

Steam power plants, using Monsanto Santosite to eliminate oxygen corrosion, are *spending less* time and money on servicing and *getting more* service out of their boilers.

Santosite (sodium sulfite anhydrous, technical) is safe, economical, easy to use. It takes *all* dissolved oxygen out of boiler feed water by combining with the oxygen to form harmless sodium sulfate. Neither Santosite nor sodium sulfate forms sludge or otherwise damages boilers or pipes.

We suggest you get complete information on the use of Santosite to eliminate oxygen corrosion by writing for the Monsanto Technical Bulletin No. O-26, "*Santosite for Removing Oxygen from Boiler Feed Water.*" MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1709 S. Second Street, St. Louis 4, Missouri.

DISTRICT SALES OFFICES: Birmingham, Boston, Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Seattle. In Canada, Monsanto (Canada) Ltd., Montreal.

Santosite Reg. U. S. Pat. Off.

MONSANTO
CHEMICALS AND PLASTICS

SERVING INDUSTRY... WHICH SERVES MANKIND

TAKE A DART APART!
you'll see at once why DARTS are your best buy!
To get top resistance to stress and stretching, we've made body and nut of high-test, air-refined malleable iron.
Special oscillating grinders give these non-corroding bronze seats a true bearing surface.
Extra width of seats ensures a drop-tight joint without excessive wrenching.
No danger of deforming or stripping with full, clean-cut threads like these.
It's an extra heavy nut so it'll easily shrug off careless wrenching.
DART
No wonder you can use Darts again and again — always count on them for extra service at lower costs.
DART
UNION COMPANY
PROVIDENCE 5, RHODE ISLAND
THE FAIRBANKS CO. — Distributors
Boston • New York • Pittsburgh

into a free-standing steel-enclosure section. Any number of sections may then be bolted and bussed together to form a *Multitrol* control center.

Ward Leonard Electric Co, Mount Vernon, N.Y.

For more data on these items, use post cards, p 167. Identify request with P and number.

WELDING UNITS P557

Two *Nelwelder* power units specifically designed to improve and extend advantages of stud welding. One is a small, compact power unit, which gives stud welding performance equivalent to two conventional 400-amp generators in parallel. It welds studs up to and including ⅝-in. diameter.

Other is a battery unit with a self-contained automatic charging device operated from any 110-v ac convenience outlet. Especially useful in construction work where power required for operation of motor-driven welding generators is not available. Unit welds studs up to ½-in. and can be easily transported in trailer units of various types.

Nelson Stud Welding Div, Morton Gregory Corp, Lorain, Ohio.

CERTIFIED WATTHOUR METERS P559

All Type I-50 meters now bear seals of certification and are shipped with certificates indicating they have met highest accuracy and performance standards at the factory. The company certifies that average accuracy of all I-50 meters shipped from the factory is within plus or minus 1/10 of 1%.

General Electric Co, Schenectady 5, N. Y.

INDUSTRIAL HUMIDIFIER P513

Complete, single-package industrial humidifier uses no ducts, pumps, compressed air or steam lines. All that is required is a supply-water feed line, which can come off the city main. No return line is required. Unit has a vaporization capacity of 1 gal per hr, weighs about 50 lb, is 12 in. wide x 14 high x 22 long. It emits water in a fine spray in just one direction.

Industrial Materials Purchasers Co, 401 Broadway, New York 13, N. Y.

VOLTAGE REGULATORS P531

Regulator controls, which are at least 99% accurate regardless of operating changes in temperature or load, are now

Who put the windows in Bus Conductors?

The "windows" are ventilating holes which Chase engineers put in to aid the dissipation of heat. They increase the current carrying capacity about 20% over unventilated tubes. And a ventilated square tube bus conductor means saving up to 36% in the weight of copper used.

When you add to this high mechanical strength, ease of assembly and erection and resistance to corrosion, you'll agree that Chase square copper tube conductors are ideal. Write Dept. PO 551 for the Chase Bus Conductor Handbook.

Chase BRASS & COPPER

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

• *The Nation's Headquarters for Brass & Copper*

Albany†	Cleveland	Kansas City, Mo.	New York	San Francisco
Atlanta	Dallas	Los Angeles	Philadelphia	Seattle
Baltimore	Denver†	Milwaukee	Pittsburgh	Waterbury
Boston	Detroit	Minneapolis	Providence	
Chicago	Houston†	Newark	Rochester†	(†sales office only)
Cincinnati	Indianapolis	New Orleans	St. Louis	

Announcing

AN IMPORTANT SERVICE TO OWNERS OF

- *Ames Steam Engines*
- *Elliott (Ridgway) Steam Engines*
- *Chuse Steam Engines*

● Concentration on other lines of production by both Ames Iron Works, Oswego, New York, and Elliott Company, Ridgway, Pennsylvania, has resulted in their discontinuing the manufacture and service of their lines of steam engines.

The first consideration of these two manufacturers was to insure the continuance of service to their past engine customers, with the result that the Skinner Engine Company was selected to be the exclusive supplier of parts and service for Elliott (Ridgway), Chuse and Ames steam engines.

Owners of these discontinued lines are assured of the same prompt attention and service as given to users of Skinner engines. *Requests for any such parts or service should be directed to:*

Skinner Engine Company
Service Department
Erie, Pennsylvania
Telephone No. 2-3661

For Over 80 Years, Doing One Thing Well—Building Steam Engines

SKINNER ENGINE COMPANY, ERIE, PA.

standard equipment on all this company's station-type induction and step regulators.

New controls allow feeders to carry heavier loads for greater distances. This is possible because with Class 1 accuracy, more feeder drop can be tolerated without at any time exceeding permissible voltage.
General Electric Co, Schenectady N.Y.

RECLOSING RELAY FOR POWER CIRCUIT BREAKERS **P539**

Type ACR is specifically designed for use on automatic reclosing equipments with all types of power circuit breakers. Completely automatic reclosing equipment protects feeders against unnecessary outages due to temporary faults, by automatically restoring service.

Relay features optional automatic reset at a definite time after any successful reclosure attempt; a self-contained means for permitting instantaneous initial and time-delay subsequent breaker tripping; and faster immediate reclosure ACR relay may be adjusted for one, two or three delayed reclosures in addition to the immediate reclosure.
General Electric Co, Schenectady N.Y.

DIRECT-FIRED HEATER **P515**

High thermal efficiency under complete automatic control are features of new standard line of direct-fired heaters ranging in capacity from 100,000 to 15,000,000 Btu per hr. Equipment serves a wide range of applications, including both indirect circulating heating using a heat-transfer medium, such as *Dowtherm*, and direct heating of liquids and vapors in temperatures up to 750 F. A new bulletin, B-45, describing this equipment is available upon application to the manufacturer. The heater fires gas or oil.
Struthers-Wells Corp, Warren, Pa.

FLOOR PATCHING **P506**

A finer aggregate added to *Armor*, a dry cementatious powder made of pulverized pure-oxidizing metal grains and four different kinds of aggregates, chemicals, and pozzuolanic ingredients.
Monroe Co, Inc, Cleveland 6, Ohio

For more data on these items, use post cards, p 167. Identify request with P and number.

The Most Carefully Built Cast Steel Valves You Can Buy

16 TESTS

Guard the Quality of LUNKENHEIMER

Figure 1938

There is only one passing grade — perfection. When Lunkenheimer steel valves reach you, they have passed a battery of tests that *assure* you of flawless quality. Incoming metals are carefully checked by the laboratory to meet high Lunkenheimer standards . . . furnace temperatures and atmospheres are tested and controlled . . . test-bars from each heat are stretched, twisted, distorted in the laboratory to assure conformance to rigid specifications . . . all pressure-parts are Magnafluxed . . . short wave gamma rays search steel castings in Radiography tests . . . seats and shells are tested hydrostatically, far above rated pressures . . . and seats are air-tested for tightness. When a Lunkenheimer valve finally reaches you, it's the most dense, sound, carefully constructed steel valve you can buy. It is available in sizes from 1½ to 24 inches with flanged or buttwelding ends. Disc guides assure accurate seating, eliminate drag . . . smooth port-to-port flow keeps turbulence down and pressure up . . . rectangular section seat rings seat firmly against the body-wall, prevent distortion.

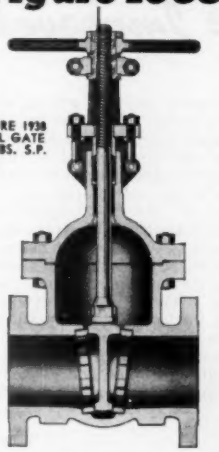


FIGURE 1938 STEEL GATE 300 LBS. S.P.

Write for your copy of "Lunkenheimer Cast Steels," and ask your local Lunkenheimer representative for more information. Address: The Lunkenheimer Co., Box 360A, Cincinnati 14, Ohio.

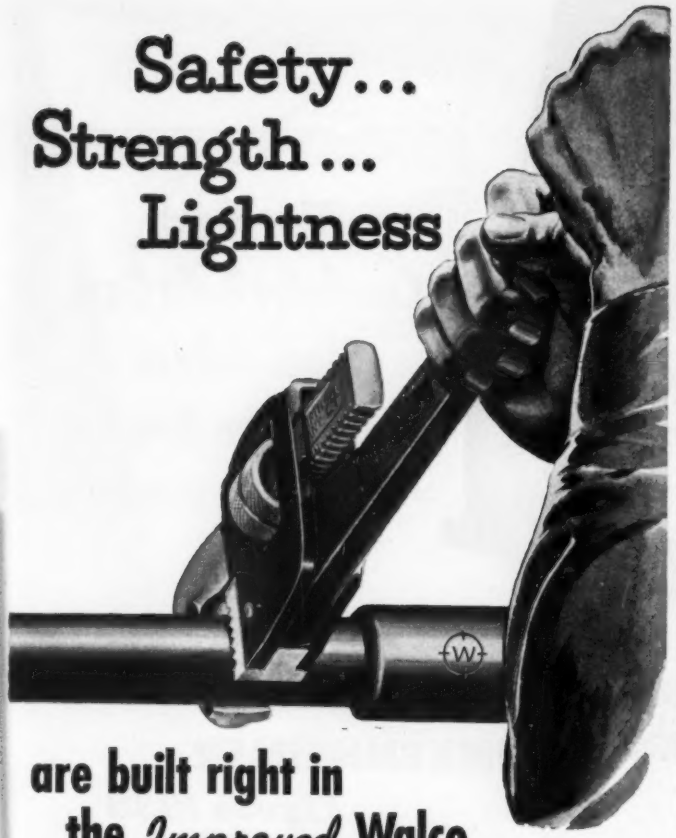
STEEL • IRON • BRONZE

LUNKENHEIMER

THE ONE *Great* NAME IN VALVES

L-251-7

Safety... Strength... Lightness



are built right in the *Improved* Walco

Walco, the strongest pipe wrench on the market today, is also the safest – and lightest all-steel wrench available. Why? Because welding – with all its inherent strength, safety and weight-reduction advantages – has been used to join the Improved Walco's housing and handle into one integral unit . . . a unit that makes the Walco so rugged that all tests show it far exceeds the requirements set up by Federal Specification GGG-651a for Type II Heavy Duty Adjustable Pipe Wrenches.

The jaws of the Improved Walco are carefully machined and will not slip; even severe abuse will not spoil the wrench's grip or quick biting action. A flexible, double-acting, quickly replaceable spring – an Improved Walco feature for which patent is pending – gives the wrench fast, positive ratcheting action. Adjustment is easy – the nut may be spun with the palm of the hand. The proper wrench opening can be determined by a calibrated pipe scale on the movable jaw.

Ask your Walworth Distributor to show you the Improved Walco – the strongest-made and longest-lived pipe wrench on the market today. Buy it – you will save money in the long run.

WALWORTH

valves • fittings • pipe wrenches

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

WITH POWER READERS

(*Continued from page 5*)

"I hate to throw these away," declared Anderson, looking over his bifocals with a glance of recognition. He was referring to a copy of POWER dated July 1914.

"Gosh," said our man, "that's kind of old, isn't it?"

Anderson explained. He's been saving his already well-read copies of POWER for some 35 years, but his home is getting a little crowded. So now he brings a few copies to work each day, gives them a last once-over and reluctantly heaves them into the waste basket.

Anderson learned the machinist trade in Sweden way back before the turn of the century, then went to sea for seven years. In 1904, he landed here and got a machinist's job at the New York Navy Yard. Twenty-nine years ago he started in his present place. In the past few years he has installed four diesel engines, replaced old hydraulic-elevator pumps with new motor-driven centrifugals, and made many improvements.

"POWER has been a big help all these years," he says, "and you know how one hates to give up an old friend."

REFRIGERATION INTERCHANGER . . .

The chart by J D Constance in your March issue (Data Sheet No. 225—"Interchanger Raises Refrigerating Capacity") has caused some concern as to the erroneous conclusions that might be drawn from it.

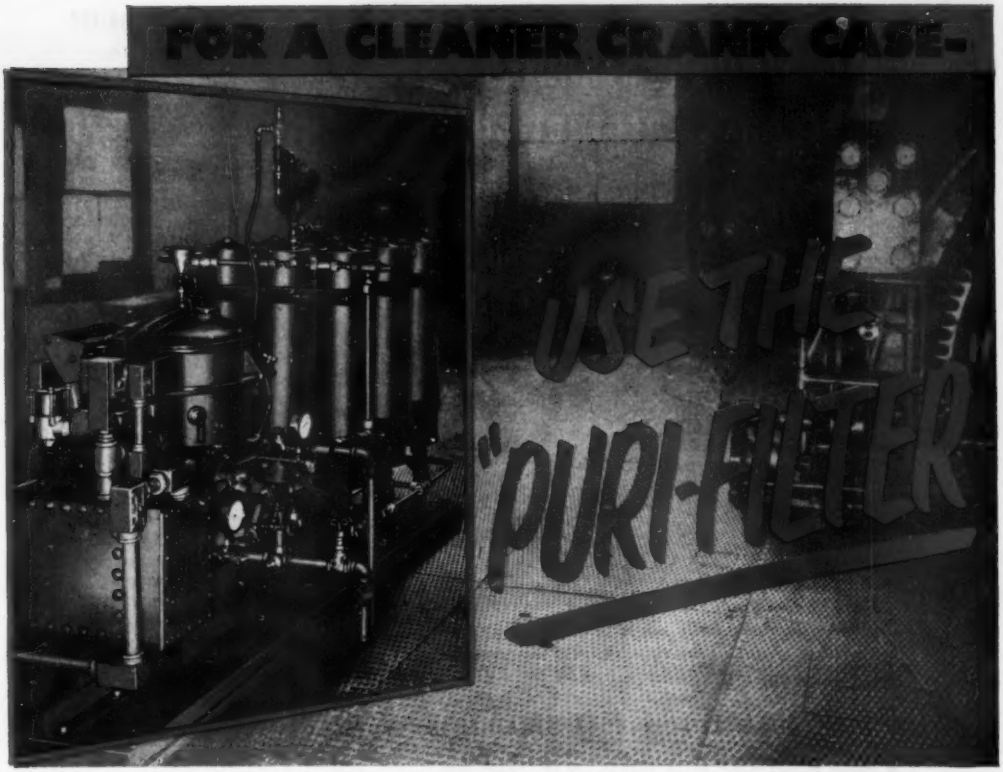
For example, at 20 F suction or evaporator temperature, refrigeration effect is 49.33 Btu per lb at 100 F condensing temperature. At 99 F and 20 F evaporator temperature, RE is 49.57, which is about a 0.5% increase in refrigerating effect in the evaporator. However, the 0.5% additional heat pickup in the evaporator per lb of refrigerant circulated is added to the suction gas going to the compressor. This increases superheat and specific volume and reduces volumetric efficiency of compression and capacity of the compressor. If the exchanger is not close to the compressor, pressure loss in the suction line increases due to greater specific volume. This further reduces compressor capacity and increases horsepower input per ton of refrigeration. If precooled liquid lines are not well insulated and ambient temperature is higher than precooled refrigerant, heat is gained. This further reduces any possible economic advantage.

Generally speaking, it is hard to justify economically the use of interchangers except on packaged units.

Precooling of liquid is accomplished more economically by using cold water or by precooling in coils located between stages in an intercooler on a multistage compressor using direct expansion for intercooling and precooling. If precooling is done to reduce flash gas on an evaporator which is float controlled, a flooded evaporator with an accumulator can be worked out so flash gas isn't carried in evaporating coils to reduce heat-transfer rate.

We have made several studies of the above problem in individual plants, most of them for ammonia, and thus wanted to try to point out the possibility of drawing wrong conclusions from the chart.

Chicago, Illinois MELVIN EWANS



A clean crank case is a direct reflection of clean lubricating oil. Crank cases of engines whose lubricating oil is purified by a De Laval "Puri-Filter" remain remarkably clean even after long periods.

The answer lies in the dual cleaning ability of the "Puri-Filter." First, the De Laval Oil Purifier removes solid impurities and water by removing them from the oil by centrifugal force. Then the partially purified oil passes through the filters which get rid of colloidal material that is lighter than the oil itself. The result is lubricating oil that is ***visibly*** free of impurities.

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TECHNICAL BRIEFS

(*Continued from page* 156)

um in dilute solution for removal of oxides is also discussed. This type of mercury treatment is used in all the mercury power plants now in service. *ASME paper No. 51-F-13.*

Corrosion

PREVENTION OF STANDBY CORROSION IN POWER PLANTS, *by Leonard Highley Jr, and W R Schnarrenberger, Hall Laboratories, Inc, Pittsburgh.* It is common practice, in taking a boiler off the line, to let the fire burn out and allow water in the unit to assume its natural level. The reason for this practice is the assumption the boiler will be ready to go back in service on short notice. If such service is not anticipated, it is preferable to prepare the unit so corrosion cannot occur. Certain specific locations in the boiler are especially susceptible to attack while the unit is idle or standing by. A number of case histories are given to illustrate the complexity of the corrosion-control problem.

Reference is made to the specific points suffering special damage during standby periods. A number of practical preventive measures are given for both dry and wet procedures of boiler lay-up. *NACE paper No. 10.*

CATHODIC PROTECTION AT STEAM-ELECTRIC GENERATING STATION, *by J H Holland and E H Thalmann, Ebasco Services, New York.* Corrosion of underground structures, applications of cathodic protection, and testing procedure for the steam-electric generating stations form the subject matter. Piping, cable sheaves and other structures are solidly connected for personnel safety primarily, and secondly for reduction of station ground resistance to the station grounding system. Usual station grounding consists of an extensive grid of heavy bare copper cable and ground rods. A galvanic cell often results from this type grounding structure and plays an important part in corrosion, particularly when the structures are in a low-resistivity soil.

Current requirements for cathodic protection of such systems range from 50 amp to several hundred, and are usually supplied from rectifiers and graphite anode-coke-breeze ground beds. Source of ground bed locations is restricted because of the need of close connections to underground structures in the typical power plant. The grounding system generally connects to transmission line shield wires or counterpoises, or to the transmission cable sheaths that carry a part of the cathodic protection current. *NACE paper No. 31.*

(*Continued on page* 190)

29 Coal Mines and Power Plants Report . . .

1. A total of 61,161,372 tons crushed.
2. Average age of American Crushers at time of survey — 9.35 years.
3. Average parts replacement cost $.0012 per ton (includes cost of standby parts not yet needed).

CONCLUSION:

AMERICANS CAN "TAKE IT"! NEEDING NEW PARTS *LESS OFTEN*, THEY KEEP OVERALL PRODUCTION EFFICIENCY *HIGH*.

HERE ARE A FEW CASE HISTORIES

A COAL MINE IN ILLINOIS reports 4,000,000 tons crushed over 10-year period by their American AC3-E Crusher — with a parts replacement cost of $.0005 per ton.

AN INDUSTRIAL POWER PLANT IN WEST VIRGINIA has an American 38-S Crusher that has reduced 10,008,000 tons over last ten years. Parts replacement cost was only $.0008 per ton.

A CENTRAL STATION IN NEW JERSEY crushed 6,000,000 tons over a 20-year period with their American 42-S. Parts replacement cost was only $.00025 per ton. Crusher still going strong.

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ORIGINAL COST of an American Crusher . . . plus MAINTENANCE . . . plus POWER . . . plus INTEREST ON INVESTMENT averages less than 1¢ per ton crushed. The American Pulverizer Company has many case studies to prove this fact.

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FIG. 408 Bronze Globe Valve

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MAGNESIUM ANODES FOR CORROSION CONTROL IN HOT-WATER STORAGE TANKS, *by H A Robinson, Dow Chemical Co.* Galvanic protection of hot-water storage tanks by employing magnesium anodes was the subject of investigation on various tank construction and protective lining materials. The effect of water temperature, water hardness, rate of water flow, and length and location of the protecting anode rod were the subjects of study.

Field tests carried out in various localities to determine the effect of water composition on the degree of protection afforded by the magnesium rod indicated for galvanized tanks a single anode rod would give a high degree of protection in about 90% of the water encountered in continental U.S.A. Refractory waters, characterized by extreme softness, a very low mineral content, and poor conductivity, required two or more anodes.

In highly mineralized water a current-limiting resistor is used to keep anode current output in line with protection requirements. Black iron or bare steel tanks are also effectively protected, but the range of application is narrower as far as water compositions go because of the higher current requirements. *NACE paper No. 3.*

CRITERIA FOR THE CATHODIC PROTECTION OF STEEL IN SOIL, *by W J Schwerdtfeger and O N McDorman, National Bureau of Standards, Washington, D. C.* A specially designed differential-aeration cell was used for the study of cathodic protection of steel in five corrosive soils. Most significant criterion was found to be the maintenance of a critical potential on the surface of a test electrode by the control of an applied current. This potential was taken at the point of intersection of the air-free potential—pH curve for steel in soil sand, and the potential—pH curve for the hydrogen electrode at atmospheric pressure. The potential runs about 0.77 v referred to the saturated calomel electrode or 0.85 v to copper-copper sulfate electrodes.

Electrodes maintained at the above potentials for 60 days lost little or no weight under conditions that produced severe corrosion of unprotected electrodes. The required current to maintain this protective potential diminished to a fairly stable value after about three weeks in four of the five soils. At this point corrosion is just stopped.

The authors cover cathodic polarization curves for steel, effect of electrode potential as indicated by the necessary applied current and a method of interpreting the approximate minimum current initially required. *NACE paper No. 6.*

(*Continued on page* 192)

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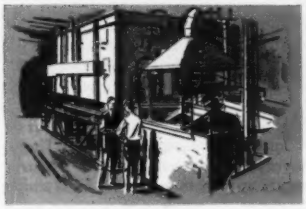

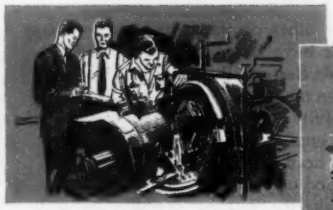

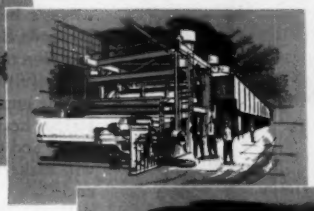

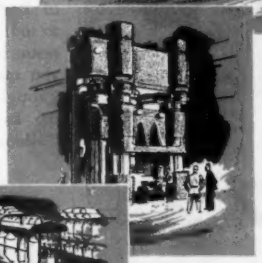

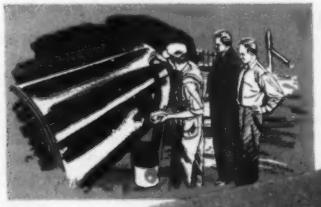

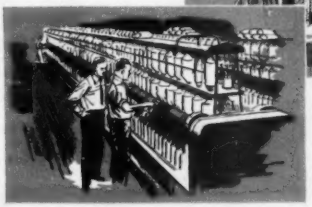

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Scraper head.
Drill, for hard deposits.
Expanding brush.
Sectional brush (internal and external types).
Cup brush for surface cleaning.
Small drills, for use with suspension cleaners.
The 600 Series motor, for tubes ½ inch up.
The Lagonda 1300 Series motor (air or steam).
The 2000 Series motor (water driven).

■ The tubes of water-tube boilers always have been easy meat for Lagonda cleaners. But that isn't all—the vibrator head shown at left will successfully jar and crack off the scale on the outside of fire tubes . . . The scraper head will clear tubes as small as ½" and up . . . Drills from ⅞" up will make the toughest deposit "cry uncle" . . . Expanding brushes, and sectional brushes will leave tubes from ¾" up as clean as a hound's tooth . . . And for even smaller tubes, there is a wide assortment of drills and brushes, driven by Lagonda suspension motors–air, steam or electric.

The above is only a partial listing of Lagonda appliances, but enough to indicate that the scope of Lagonda resources covers just about any tube you may need cleaned. If you have a tough job, call in the Lagonda man. Bulletins at request.

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Cooling Equipment

SELECTION, OPERATION AND MAINTENANCE OF INDUSTRIAL COOLING EQUIPMENT, *by H E Degler, Marley Co, Inc, Kansas City, Kan.* Recent headlines of water crises in New York City and elsewhere have brought to public attention basic water shortages. Conservation and reuse of water have become a necessity in many areas. Water can, of course, be purified ,cooled and reused. And this is happening more and more.

Among the large industrial water users are power plants, paper mills, petroleum refineries, the textile industry, and some of the food processing plants. Their requirements may go as high as 300 lb of water per lb of finished product. Water usage, in general, has doubled in the past decade, so selection of cooling equipment becomes more important as power demands increase.

Mechanical-draft cooling towers are one form of cooling equipment. They can evaporatively cool water to a temperature approaching the wet-bulb temperature of the ambient or entering air. This evaporative method requires less than 1% evaporation of the cooling water circulated to dispose of the heat load economically.

Air-cooled fin tube exchangers are a second form of cooling equipment. They are enjoying an increased acceptance for "high-level heat removal" work (above 140 F referred to 100-F dry-bulb air as an example).

The author shows how the performance and life of any cooling equipment depends on its inherent qualities, its type of service, operation, general care and maintenance. *ASME paper No. 51-S-7.*

ELECTRONICS

(*Continued from page* 101)

the armature, and thus its speed, is controlled. How the output of a gas-filled tube is controlled by an ac rider voltage and a dc bias was explained in POWER, Nov 1950, p 120, and Dec, p 123.

Control Operation. Let us now follow through the control operation. When the power switch is closed, transformer primary *PT* is connected directly across the line. As a result all four secondaries are energized so S_1 and S_2 immediately heat the cathodes of the tubes in readiness for them to go into service. As soon as tube T_3 conducts, the motor's shunt-field winding is energized. This circuit is from center tap *T* on S_4 through R_4, shunt-field winding to center tap on S_2 and to either cathode and anode of T_3 depending on S_4 polarity. Field coils are now excited, ready to start the motor by closing the start button.

Closing this button completes con-

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Jeffrey Chains and Sprockets are being put through the acid test of actual service on thousands of tough jobs . . . especially where the demand is for high-quality products. They are in universal use for unit machinery, for conveyors and bucket elevators, and for transmitting power. Follow the lead of those engineers who know the importance of "good chains and sprockets." Send for our new Catalog No. A-418 which goes into detail.

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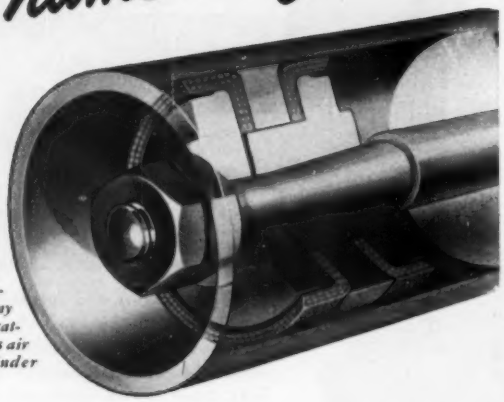
You name the fluid...



Phantom cutaway showing typical Pumcup-piston assembly—one of many types for all reciprocating pumps as well as air or hydraulic cylinder mechanisms.

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IN thousands of plants, Darcova Pumcups are solving the problem of diminishing pump efficiency, repacking, maintenance, down-time, lost production—the things that really eat up dollars in fluid-handling operations!
Here's why . . .

1. Darcova composition Pumcups not only increase volumetric efficiency, but they *keep* it high with no appreciable fluid slippage for the entire life of the Pumcups.
2. And, because of their design, composition, and operating principle, Pumcups have *many times the life* of most other types of piston packing.
3. Based on years of application research, Pumcups come in standard and special compositions for exceptional stability in handling almost *any* fluid you can name. For example . . . strong acids and alkalies, food products and even the most troublesome petroleum derivatives.

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tactor coil M circuit, and contacts M and M_1 close. Contact M makes a holding circuit around the start button so it can be released and coil M remains energized. When M_1 closed, it completed the armature circuit from L_1 through the armature, overload coil OL, tube T_1 to L_2. Motor comes up to a speed determined by the setting of the potentiometer's contact arm.

Grid Voltages. The network formed by secondary S_3, resistor R_2 and capacitor C_2 puts an ac rider or ripple voltage on the grid of tube T_3 for control of the tube's output and motor speed, as previously explained. When S_3 has the polarity shown, the ripple voltage is applied through R_2 and R_3 to the grid and cathode through the motor's armature R_4, part of potentiometer P, to center tap on S_4. This voltage is about 100 deg out of phase with the anode volts. By raising or lowering this voltage with a dc potential the point on the anode voltage wave at which the tube fires can be advanced or retarded. In this way the tube's output and motor's speed can be controlled.

Volts' drop across R_4 is applied as a minus bias to the grid of tube T_1 so this tube's output can be reduced for low motor speed. Assume the potentiometer's arm is on N_1, then volts' drop across R_4 is applied to the grid of tube T_1 from N_2 through S_3 to grid and cathode, and armature to N_4. This bias lowers the ac rider to delay the tube's firing and gives low armature speed.

Control of Tube Output. There is a circuit directly from center tap T on S_1 to N_1 through potentiometer P and resistor R_1 to center tap on S_2. This puts the full rectified voltage of S_1 across P and R_1. Since they have equal resistance, half of this exists across each resistor. Assume that the potentiometer's arm is moved from N_1 to A, and voltage drop between these points equals that across R_1. These voltages oppose so the dc bias on the grid of tube T has dropped to zero. The tube then fires at a point in the anode voltage wave, determined by the rider voltage only.

Moving the potentiometer's arm to the left of A applies a plus dc voltage to the grid of tube T. Assume the arm is moved to N, then the dc grid voltage is applied from T on S_2 through R_4, the armature, cathode and grid of tube T_1, resistor R_3, through the phase-shift network to N, R_1 and to S_2. This applies a dc plus voltage to the grid circuit equal to that across P, minus that on R_1. This potential lifts the ac rider to where it causes tube T_1 to conduct during the whole anode voltage wave for full armature speed. Therefore, by moving the potentiometer arm from N to N_1 we can control the motor's speed over the full range from low to rated value.

This control is also available for re-

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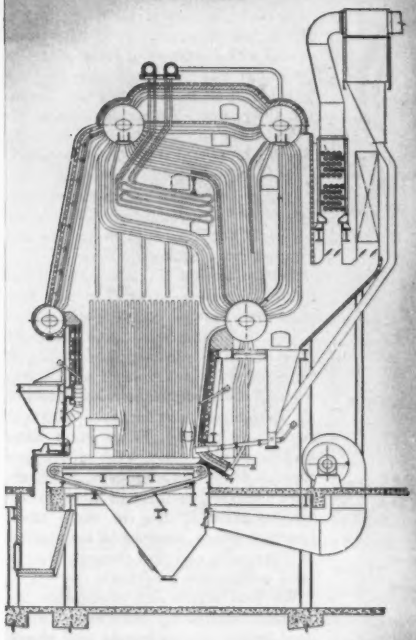

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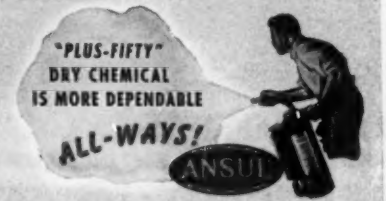

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versing service from a push-button station. Where quick stopping is needed dynamic braking may be had. In Fig. 3, the armature is supplied directly from a 220-v line. If 208- or 220-v ac power is not available a transformer designed for the motor's rating is used to give the correct voltage.

LOW-COST FILTERS

(*Continued from page* 75)

baffle and chain-type steam separators were fitted to engine exhaust lines ahead of process. Trap discharges oil-and-water mixture to waste.

Sparkler horizontal plate-type filters, which use unwoven rayon fiber precoated with a mixture of Johns-Manville Sorbo-Cel and processed asbestos, did best job of oil removal. We feed Sorbo-Cel slurry into condensate ahead of filters; slurry attracts oil in condensate and holds it until it reaches the filters. Here it collects on the plates and builds up a cake. Operation is continuous until there's no more room for cake between plates. When this happens plates are removed for cleaning.

System Design. Fig. 1 shows entire filter-station installation; Fig. 4, a flow diagram of system. This is how it works.

Process condensate from different parts of plant collects in header, Fig. 4. From here it flows to heat exchangers where its temperature is reduced to 125 F. Exchangers discharge to 6000-gal condensate receiver. Filter pump takes suction from receiver, discharges through filters to a surge tank. Receiver-level controls flow through filters by actuating valve in line to surge tank. Constant pump pressure is maintained on filter cake, and flow through filter is same as that into condensate receiver.

We feed slurry into condensate between booster pump and filters. To get good mixing of condensate and slurry we put a turbulator in the line just after slurry feed point. Distance between turbulator and filters is 40 ft. This allows enough time for oil adsorption before oil and solids are retained in filter cake.

Filters operate about 70 hours between cleanings. By that time all cake space in them is filled. To clean, we remove the plates with a ½-ton-capacity electric hoist, Fig. 2. Plates are separated, and cake is washed from them with water from a hose. When clean they are returned to filter tank and given a Sorbo-Cel precoat. Agitators in precoat and slurry tanks give mixture of proper consistency. Piping is arranged so any filter can be cleaned while others are in operation.

When preparing filters for operation after cleaning, pressure is taken off filter. Precoat-and-water mixture is allowed to fill filter to capacity. We feed

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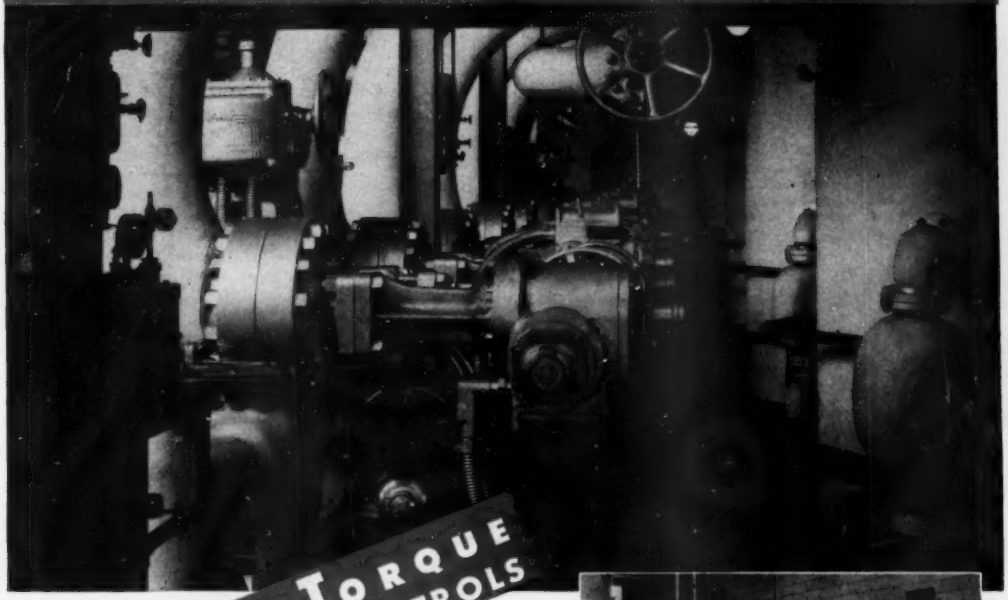

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In hundreds of Central Stations, Power Plants, Water and Sewerage Works throughout the world, LimiTorque Controls were chosen for reliability, safety and accuracy.

LimiTorque Remote Control permits one man to operate and to know the status of each valve at a central push-button control station. This is an important safety factor as men are not required to go to high, low or dangerous locations for manual operation. Further, LimiTorque automatically shuts off power should an obstruction occur in closing, thus protecting the valve parts.

LimiTorque is available for all makes and types of valves, and is adaptable to existing equipment. Actuation can be by any available power source . . . electricity, steam, water, gas, oil or air.

Upper: LimiTorque operators on high-pressure feed water heater valves.

Lower: LimiTorque Control on a King valve with reversing control and push button station.

Our LimiTorque Catalog is yours upon request. Please write on your business letterhead.

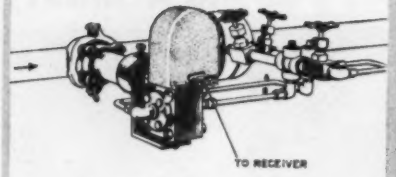
Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON

IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls



The d/p Cell can be installed close to the orifice with short lead lines. Because of zero displacement, condensing chambers or seal pots are omitted.

Simpler Flow Measurement

in the palm of your hand

NEW • REVOLUTIONARY • MERCURY-LESS

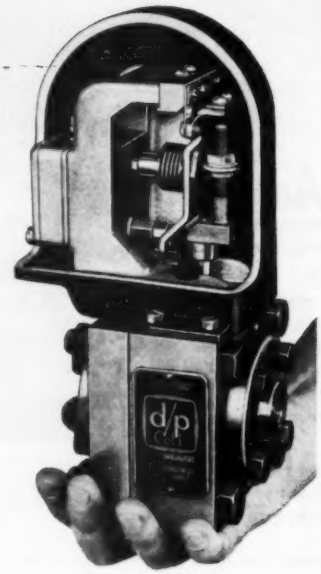
FOXBORO

DIFFERENTIAL PRESSURE CELL

Now you can simplify many troublesome flow problems . . . especially those where corrosion is a factor or the use of mercury is objectionable. This unique flow measuring device is accurate, easily calibrated, and widely applicable, and it weighs only 20 lbs.

The Foxboro d/p Cell operates on the highly - accurate force - balance principle, transmitting flow measurement to remote, conveniently-located pneumatic receiving instruments (indicating, recording, controling). Range 25 in. to 800 in. H_2O. Working pressures: 750 psi and 1500 psi.

Get all the facts about this revolutionary new device for the measurement of liquid, steam, gas or air flow. Write for Bulletin 420. **The Foxboro Company, 685 Neponset Ave., Foxboro, Mass., U.S.A.**



UNIQUE ADVANTAGES

1. *Steel or Stainless Steel Construction.*
2. *Uses no mercury.*
3. *Essentially zero displacement — no need for condensing chambers on steam measurement or seal pots on liquid measurement.*
4. *Immediate, unfailing response to differential pressure changes.*
5. *Positive overrange protection.*
6. *Easy zero and range adjustment.*

FOXBORO REG. U.S. PAT. OFF.

RECORDING • CONTROLLING INDICATING **INSTRUMENTS**

slurry until effluent is clear. When setting up this system we had to study operation carefully and make changes here and there because the filters were not originally designed for oil removal.

Dosage. Quantity of oil in condensate fluctuates while plant is on the line. So Sorbo-Cel dosage varies too. Using a basis of 3 parts Sorbo-Cel to 1 part of oil to be removed, dosage is regulated to take care of peak amounts of oil as determined by routine analysis.

Results Obtained. We reclaim 1000 lb of condensate at a total cost of about 1.7 cents for labor and material. In 1946 boiler feed was 50% condensate; today it runs between 80 and 85%. Oil-filter effluent has an average of less than 1.0 ppm of all materials determinable as oil. Since boilers produce about 2 million lb of steam per day, oil removal has been highly profitable. In addition, steam-plant operation has been most satisfactory.

MARMADUKE

(Continued from page 146)

evening, when a stocky man walked in. He slapped a hundred dollar bill on the bar and announced, 'The drinks are on me, boys, I'm foreman for the General Iron Works and my name's Jack Geppert. I need a dozen men to help me erect some machinery at the Golden Cycle mine. And if there's a boilermaker in the house, I'll pay him 10 dollars a day until the job's finished.'

" 'Stop right there, mister,' I piped. 'I just piled off an Alaskan steamer in Seattle. I've done everything from steam fitting ashore to engineering aboard ship. I came here to do a little prospecting, but I'll feel more at home around boilers and a pile of coal.' Next morning I showed up early at the mine.

"The Golden Cycle went to a depth of over two thousand feet and had twenty levels. Her power plant already had ten 650-hp watertube boilers. And she needed all those boilers to run the air compressors and the big double-decker hoist in that mine shaft.

"Those boilers also supplied the steam to large duplex sump pumps. The pumps had 16-in. diameter liquid cylinders and were scattered around on various levels. The largest drainage sump was on the lower level.

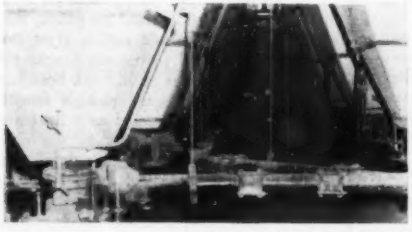
"They had fifty air drills going full blast in the mine at that time, each using about 100 cu ft of air. As I remember it, the three air compressors were of about two thousand, fifteen hundred and seven hundred cu ft capacity. What with the drills, pumps and that double-decker hoist working steadily, the powerhouse was no slouch. And the boilers really ate up coal

"Victor was a wide-open mining town

One of our latest ALL-PNEUMATIC systems

A-S-H Automatic Dust Mixer and Unloader at Potomac River. This new generating station is at Alexandria, Virginia, within view of the Nation's Capitol.

PEPCO's new $25,000,000 Potomac River Power Station, with a projected capacity of 400,000 kilowatts, is now operating two 80,000 kilowatt units. Each of these units has an 800,000 lb-per-hr boiler designed initially to burn pulverized coals having an ash content of from 4.5 to 12%. The furnaces have dry hopper bottoms with shaded ashpits that are much cooler than those of conventional design. Bottom ash is removed in a completely dry state by gravity discharge through manually-operated slide gates into the vacuum transport system. This operation requires the time of one operator for only about 20 minutes every eight hours. The 33 fly-ash hoppers on each boiler unit are emptied automatically by this same pneumatic system.



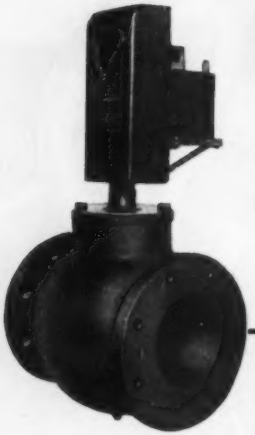
A few of the fly-ash hoppers, showing A-S-H air-electric operated Dust Valves.

Whether, like Potomac, your situation calls for a pneumatic system, or whether it would be better adapted to a hydraulic system, it's wise to consult our experienced engineers. We've been designing all types and combinations for many years, and you can depend on our recommendations.

THE ALLEN-SHERMAN-HOFF CO.
227 South 15th Street, Philadelphia 2, Pa.
Offices and Representatives in Principal Cities

HYDROJET (hydraulic) HYDROVAC (pneumatic)
materials handling systems

FIRE EMERGENCY SHUT OFF!

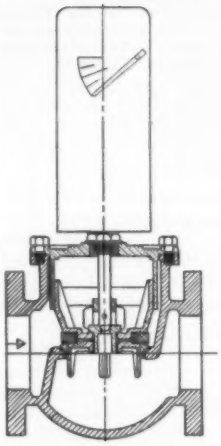


DAVIS NO. 300-S MOTOR OPERATED VALVE

IN industrial plants using large quantities of service water, it is necessary and often an insurance requirement to have a valve installed in the house service system that will close automatically when the sprinkler system goes into operation and remain closed until the fire is extinguished.

The Davis No. 300-S Motor Operated Valve is specifically designed to meet this requirement. It can be actuated by the sprinkler system in either of three ways:

1. Electrically connected to fire pump or electrical alarm circuit.
2. Electrically connected to a pressure switch installed in the supply line to the hydraulically operated alarm in a dry system.
3. Electrically connected to a flow indicator switch located in sprinkler system pipe line.



NO WATER HAMMER!

No. 300-S features Davis' famous tight-closing, non-sticking, single seat, pilot stem design. Renewable disc; no internal packing. Two position motor; current consumption 24 watts when running; no stand-by consumption. Visible position indicator, 30 second timing.

Davis builds this valve in sizes, ½" to 6", complete with low voltage transformer for connecting direct to 110 or 220 volt, 60 cycle A.C. current. Shipped complete with wiring diagrams and installation instructions. See your local distributor or write for complete information.

DAVIS REGULATOR COMPANY

Established 1875

2540 So. Washtenaw Ave., Chicago 8, Ill.

Distributors in Principal Cities Throughout the United States

of 20,000 people then. It was the kind of a town any seaman could feel at home in. Everyone had money and you didn't have to go far to pick a fight for a little entertainment.

"And when it comes to power-plant mechanics, you won't find many to match those oldtimers I worked with. The steep hills around were dotted with mines, with a boiler or two perched on top near a mine shaft. You wondered how that heavy equipment got up there. Answer was the famous *rocky mountain canary*—better known to strangers as a burro.

"The burros carted up one piece of a machine at a time and the mechanics would put them together by hand. The General Iron Works even made steam cylinders for their engines in segments. Then they were fitted together on the spot.

"By the time those boilers were finished and put on the line, the mine superintendent offered me a job as his assistant, in charge of the power plant. I accepted.

"My biggest job was helping the firemen keep their steam on the line and preventing any delays and breakdowns. With a lot of green help around who had never had a slice bar or monkey wrench in their hands, it kept me busy. Trouble was everyone dreamed of getting rich, and held a job only long enough to earn a grubstake.

"A few weeks after I took over, I had a chance to visit the large pumps on the various levels. When I got to the first level, I found the pump tender sleeping in a hammock he had rigged up.

"A swift kick midships near his bilge keel sent him zooming out of there like a flying fish. When he landed and came to, he yelled, 'What's all the shootin?'

" 'You were hired to tend this pump,' I answered, 'not to pound your ears in a hammock.'

" 'Hold your horses,' he yelled, rubbing his bottom and getting right side up. He pointed to the sump near the pump. There was an old oak beer barrel rigged up to the pump's throttle valve. The barrel acted as a float and kept the pump running at the right speed to hold the sump's level constant. While I looked at that rig, he stood there beaming.

" 'Well now,' I finally said, turning to him. 'This automatic rig works so well I don't see why we should have to pay you any more.'

" 'That's a hell of a way to reward a man for using his head,' he squawked. 'She works, so what's the difference if I sleep or not?'

" 'Look here, Lamebrain,' I answered, getting up steam. 'I knew about this

(*Continued on page 204*)

IT ALWAYS PAYS TO SPECIFY

LADISH

Controlled Quality

PIPE FITTINGS

...you know they are in to stay

Long, trouble-free piping service results from extra safeguards in the manufacture of Ladish fittings. Rigid laboratory controls over chemical composition and physical properties of steel provide an assurance of maximum strength and resistance to erosion or corrosion. These are some of the extra safeguards for dependable operation which you always get in greatest measure in Ladish Controlled Quality Fittings.

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF...ONE RESPONSIBILITY

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District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
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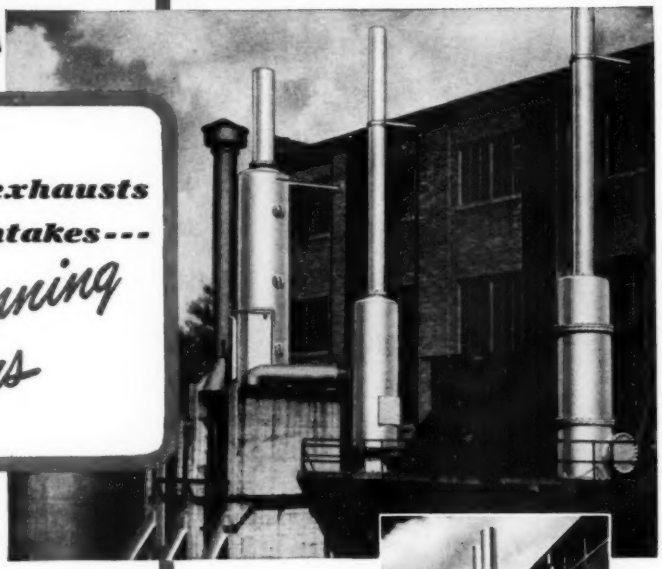
POWER STATION



For quiet engine exhausts and compressor intakes--- select

Burgess-Manning Snubbers

● In utilities and manufacturing plants, on Diesel locomotives and boats, in the chemical and petroleum industries . . on engines and compressors of all sizes and makes, you will find Burgess-Manning Snubbers effectively quieting the pulsating roar from engine exhausts and the throbbing suction of compressor intakes. Burgess-Manning Snubbers are scientifically designed to smooth the flow of exhaust gases and intake air. Noise is reduced to the desired sound level. Performance of equipment improved. Reduced maintenance.

For a practical solution of your engine and compressor noise problems call Burgess-Manning: sound engineering recommendations; sturdily constructed, reliable products; guaranteed performance.

BURGESS-MANNING COMPANY

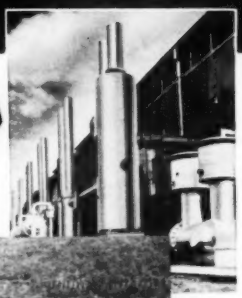
749 East Park Avenue, Libertyville, Illinois

YOU CAN DEPEND UPON BURGESS-MANNING ENGINEERS FOR A QUALITY PRODUCT AND SOUND ENGINEERING COUNSEL

- A quarter century's experience.
- Engineering and installation know-how gained by work in hundreds of industries.
- Broad line of Snubbers in a wide range of sizes and noise reduction capacities.

Write for Bulletin
"Bring Your Plant Up To Date With Burgess-Manning Heavy-Duty Slug Buster Snubber."

PIPE LINE STATION

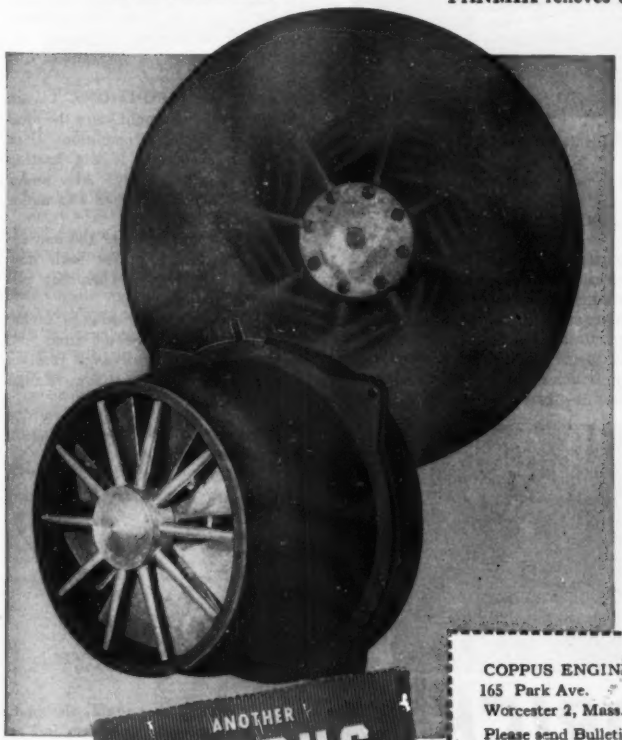


BARGE

ENGINE TEST HOUSE

DIESEL LOCOMOTIVE

You get MORE CAPACITY with a FANMIX BURNER



Increase Boiler Ratings On Present Or Planned Equipment

In all types of Coppus-Dennis FANMIX Burners — straight gas or combination gas-oil — we utilize the energy of the fuel under pressure to drive the burner fan and deliver air in the proper proportion to the fuel flow. This exclusive "pinwheel action" *mechanically* mixes fuel and air in exactly the right proportions for truly radiant, non-luminous heat.

The result is uniform temperature everywhere in the combustion chamber — no drifting "hot spots" — and complete combustion under all conditions. That's why you can release more heat into your present furnace — why in new installations you get more heat into smaller furnace space.

FANMIX Saves On Both Old and New Installations

FANMIX can easily be operated with your present furnace and stack, requiring only minor changes in other equipment. Or if you're planning on new boilers, remember that FANMIX relieves the furnace from the burden of mixing, creates its own forced draft and takes smaller pipe sizes. Which means you can plan on reduced combustion space, less stack, no forced draft equipment and lower installation costs all around.

Get the Whole Story

Coppus engineers FANMIX Burners to meet individual requirements, providing complete control over heat pattern and combustion . . . Learn more about how "pinwheel action" can step up *your* boiler performance to peak efficiency and economy — as it is doing throughout industry. Send for Bulletin 410-6. Coppus Engineering Corp., Worcester 2, Mass. Sales Offices in THOMAS' REGISTER. Other Coppus "Blue Ribbon" Products in BEST'S SAFETY DIRECTORY, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG, and MINING CATALOGS.

COPPUS ENGINEERING CORP.
165 Park Ave.
Worcester 2, Mass.
Please send Bulletin 410-6 to:
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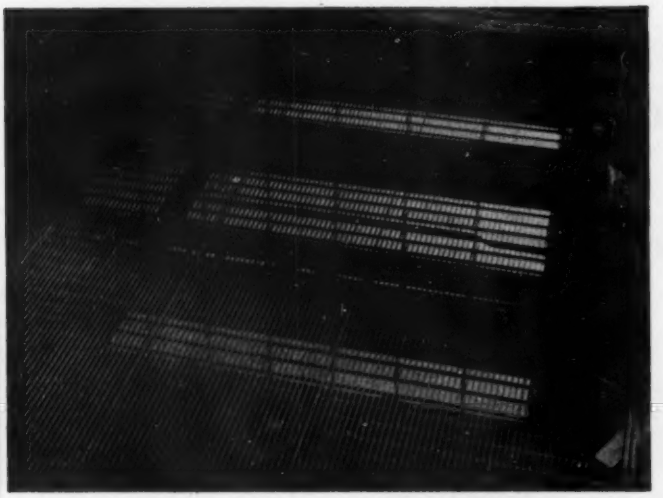
Where you need light and air

use Hendrick Open Steel Flooring with its 90% open area



PLENTY OF LIGHT AND AIR THROUGH THREE FLOORS

With its minimum obstruction to the passage of light and air, Hendrick Mitco Open Steel Flooring will support heavy loading without any lateral deflection of the steel bars.

Made into integral panels, under hundreds of tons of hydraulic pressure, there are no bolts, rivets or angle irons to loosen, or to collect dirt or refuse—no welds, liable to have residual stresses and lead to warping.

* * *

Unequalled for floors, loading platforms, ramps and driveways that have to withstand heavy traffic, Hendrick Mitco Armorgrids do not depend on the fill for development of full strength to resist shock loads.

The rectangular, square-edge bars provide a thoroughly safe, non-slipping, level walking surface.

For stairs, ladders and fire escapes, Hendrick Shur-Site Treads offer all the advantages of Mitco construction. A valuable safety feature is a heavy, flanged nosing-bar that gives sharp visibility to the edge of each tread and also provides additional strength where the load is greatest.

Write for Catalogue of Hendrick Mitco Products

SEE OUR CATALOG IN SWEET'S

HENDRICK

Manufacturing Company

46 DUNDAFF STREET, CARBONDALE, PENNA.

Sales Offices In Principal Cities

Perforated Metals
Perforated Metal Screens
Wedge-Slot Screens
Architectural Grilles
Mitco Open Steel Flooring,
Shur-Site Treads, Armorgrids

stunt long before you ever heard of a pump. And so did the superintendent. But there's a lot of human beings working in this mine. And if this rig fails—and I'd like to see the automatic hookup that don't at times—it might be disastrous for all of us.'

"'I'm a shift operator from Boston and I came west to prospect for gold,' he explained. 'How about shifting me to the power plant until I have enough money for another grubstake?'

"'Since you're an operator,' I answered, 'you don't need a grubstake because you've struck gold right now—if you remember this rule: *never, never, depend one hundred percent on automatic equipment when there's lives at stake.*'

"'And to make sure you don't ever blow that treasure, I'll emphasize it a little. YOU'RE FIRED.'"

PLANT PROBLEMS

(*Continued from page* 138)

possible and insulate in one bundle.

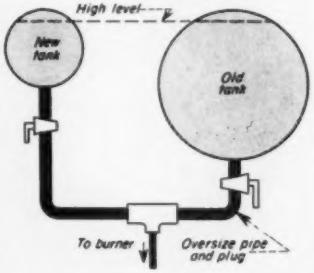
If steam return line is brought back to boiler room, run in same bundle with other lines.

O MEYER *Bogota, N. J.*

DEPENDS ON CONDITIONS. To answer completely, I should know the kind of plant, the operating conditions. Does it run year around or is it a heating plant run in winter only? Also under what codes is it constructed and under what code operated?

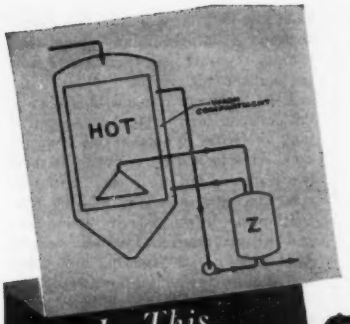
To tie two tanks together and operate as a single tank requires both new tanks be same elevation. Then they will have same head pressure.

In general, with two storage tanks, it's preferable to draw off from one tank, holding other full as a reserve. When fuel in first tank is low, change

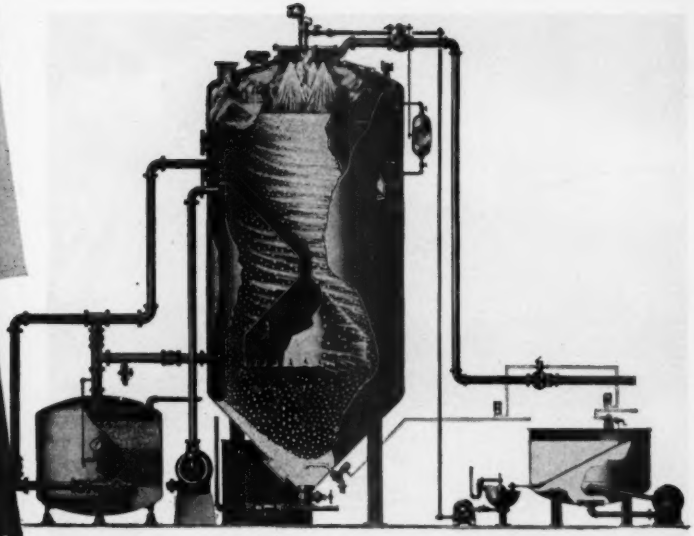


over to second tank and fill the first. In this way, one tank is always full as a reserve. Also, it's best to take one tank out of service for inspection or servicing at intervals.

If tank is tied off from present connections to existing tank, that will avoid possibility of cold oil plugging pipe



In This
WORTHINGTON
HOT-Z
Deaerating Type Water Conditioning System . . .



Built-In Annular Wash Water Compartment Supplies and Reclaims Backwash Water

Independent of the Softening Process

No other Hot Zeolite System offers you so many advantages as this Worthington Hot-Z System. A quick review of the vital facts will show you why.

As you probably know, Hot Zeolite beds require periodic expansion to minimize packing and friction loss, and to insure efficient contact of each Zeolite particle with its share of dissolved impurities. This need for bed expansion occurs not only during the regeneration routine, but also several times during the period between regeneration routines. That's why it is important for you to use clean, softened water, preferably at normal operating temperature, for the reverse flow or "backwash" operation.

Worthington does it!

The Worthington Standard Hot-Z System with its backwash feature provides a built-in annular wash water compartment that supplies and reclaims backwash water . . independent of the system's softening process. In this compartment, backwash water is cleaned and maintained at normal operating temperature.

This backwash feature pays off particularly in systems employing filters because it *makes filter beds last as long as eight years.*

Other advantages

Worthington Hot Process Systems come equipped with modern, direct contact vent condensers. This means, no more of the scaling trouble that made the old-fashioned shell and tube types such a nuisance.

In addition, Worthington Hot-Z Systems operate on low-priced lime and salt. That's why the average installation saves enough in chemical costs to pay for itself in 3 years.

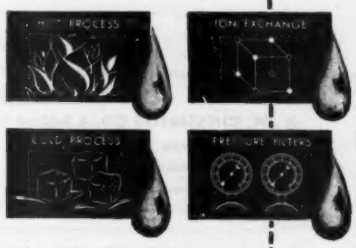
Get all the facts!

It will pay you to investigate the Worthington Hot-Z System thoroughly. Tell us your conditions of service and get our recommendation in terms of dollars and benefits. You'll find in our Hot-Z System, as in so much other equipment, *there's more worth in Worthington. Worthington Pump and Machinery Corporation, Water Treating Section, Dunellen, N. J.*

WORTHINGTON

WATER CONDITIONING

Worthington Makes More of the Equipment for All Types of Water Conditioning Systems



JJ-1

ARE YOU PACKING PUMPS

when you could be catching trout?

If you are spending your week-ends repacking pumps, you should repack with CHESTERTON "Parachute" Packing. Each ring is self-sealing and permits individual lubrication. The bottom ring has straight sides and can't roll in the stuffing box. CHESTERTON "Parachute" lasts longer, requires no attention, needs no gland pressure and adjusts itself automatically to retain full compression seal. No special adapters are required. This fully automatic packing can cut your packing costs in half at the same time it cuts your repacking time. Specify 600W for water, 600S for steam. 600HO for hot oil and 600CO for cold oil. Ask your distributor or send for full description of CHESTERTON "Parachute". *For longer, carefree week-ends, away from the job, Specify "Parachute".*

Chesterton *Parachute lasts longer*

PACKING Chesterton GASKETS

A. W. CHESTERTON CO., 6 Ashland St., Everett 49, Mass.

☐ I would like more data on "600"

☐ Who is my local distributor?

Name _____

Company _____

Street _____

City _____ State _____

from idle tank. This will be less expensive and a simpler piping system than running separate lines to each tank from the boiler room.

FMC mentions a steam line to tank, but does not say if he uses steam coil in tank, or heater in suction line from the tank. Also, he doesn't say whether there is a return of hot oil to tank. If hot oil return, a small trickle of oil should be continuusly drawn off from reserve tank and an equal amount of hot oil returned. That prevents oil "freezing up" below temperature at which it flows easily.

Any of three hookups FMC suggests will work.

If cold weather he mentions is final deciding factor, tying tanks together with large pipe and operating as a single tank might be best solution, my sketch. If I selected this hookup, I would set the second tank so the high coils of both tanks are same, if their vertical dimensions are different. Then I'd put a plug arch in the outlet connection from each tank so that either tank could be taken out of service if necessary.

H T LIVINGSTON *Los Angeles, Calif.*

TWO LINES. Check with state inspectors so you comply with code. Then run separate lines from new tank to boiler room.

C H ELBERT *Irvington, N. J.*

POWER NEWS

(*Continued from page* 152)

followed by six films presented on a more technical level. The latter group shows how to select and apply polyphase induction motors, single-phase integral-hp motors, dc motors, synchronous motors, adjustable-speed drives and gear motors.

Henry Disston & Sons, Inc. Essentially an educational effort to cut waste of time, tools and materials, this company's program supplies workmen with individual "Fight Waste Cards" each applying to a specific cutting tool and aimed at correcting operation, improving workmanship, prolonging tool life.

In addition to the individual cards are booklets entitled, *The Pocket Foreman*, containing a reprinting of all the cards, plus information on applying the program to a department.

Quaker Rubber Corp. With the general aim toward conserving rubber and increasing production with present equipment, the Quaker Rubber Corp has developed a Conservation-Maintenance Plan. The package plan consists of a handbook, wall charts and monthly bulletins. Data contain hundreds of illustrations and suggestions on how to select,

install and maintain conveyor belting, flat transmission belting, hose, V-belts, and packing.

The plan is offered to all industrial plants and may be had by writing to Quaker Rubber Corp, division of H K Porter Co, 1932 Oliver Bldg, Philadelphia 22, Pa.

COMING EVENTS

May 4—Anthracite Institute, ninth annual anthracite conference, Lehigh University, Bethlehem, Pa. A C Callen, general chairman, Lehigh University.

May 6-10—Air Pollution and Smoke Prevention Assn of America, 44th annual meeting, Hotel Roanoke, Roanoke, Va. C S Frost, chairman.

May 7-11—Greater New York Industrial Show, Technical Societies Council of New York, Inc, Armory, 34th St and Park Ave, New York. Orkin Management, 8 W 40th St, New York, N. Y.

May 10-12—New York State Society of Professional Engineers, Hotel Statler, H Carl Bauman, chairman, N. Y. State Society of Professional Engineers, 1941 Grand Central Terminal, N. Y. 17, N. Y.

May 24-25 — Pennsylvania Electric Assn, spring meeting. Penn-Belle Hotel, Bellefonte, Pa. E Gordon, chairman, Potomac Edison Co, Hagerstown, Md.

Davis Dam Plant Goes Into Operation

Pressing a key in Washington, D. C., Secretary of the Interior Oscar L Chapman placed in operation the first of the five 45,000-kw generators at the Bureau of Reclamation's Davis power plant. This plant is on the Colorado River between Nevada and Arizona, 34 miles west of Kingman, Ariz., and 67 miles downstream from Hoover power plant. It is the fourth largest hydroelectric power plant of the Bureau. It will be generating to full installed capacity of 225,000 kw next summer when all units are to be in operation.

Integrated by a 230-kv line with the Bureau's Parker power plant, 86 miles downstream, generation at Davis is important at this time during the nation's greatly expanding defense effort. At full production, Davis will generate about a billion kwhr of energy a year. The dam, an earth- and rock-fill structure 138 ft high above the river bed and 1600 ft long, is completed. It is the last of the major reclamation dams that are to be built below Hoover in the presently planned development of the Colorado, as it utilizes the last major power drop of this section of the river.

Rock Island Plant Expands

Puget Sound Power & Light Co's Rock Island hydroelectric generating plant, on the Columbia River near Wenatchee, Wash., will be enlarged to produce an additional

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Here is a modern packing, so tough that it stands up under severe conditions; so "plastic" that hand or gland pressure squares it up to the required stuffing box size. Chesterton 550 Plastic Packing is an extruded compound of special long-fiber asbestos, high grade lubricants and anti-frictional, non-scoring components that are not subject to flux up to approximately 1000°F. Ideal for use on centrifugal and rotary pumps. Your local Industrial Jobber stocks 550. Order from him today.

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These Bowser turbine oil conditioners are serving two 12,900 c.f.m. and two 52,000 c.f.m. turbo-blowers.

For the first six months following installation the oil in each unit was tested every thirty days. It was found to be in such continuously perfect condition that the user* considers further tests unnecessary.

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these 8 enemies of turbine performance!

1. Turbulence
2. Air Entrainment
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8. Dust

Bowser turbine oil conditioners keep turbine bearings "on-the-job" in most power generating plants. Costly shutdowns are avoided and less standby equipment is required.

Write today for your copy of the new bulletin on the improved Bowser turbine oil conditioning method.

*NAME ON REQUEST

BOWSER, INC., 1326 CREIGHTON AVENUE, FORT WAYNE 2, IND.

FUEL OIL CONSUMPTION METERS • INSULATING OIL CONDITIONERS

120,000 kw under an agreement reached by the company with the Chelan County PUD of Wenatchee.

The $26,000,000 expansion will be financed by PUD, to whom the company will lease "such of its structures and facilities at Rock Island as are necessary" for financing. The present plant, with a low dam and four generators, produces 80,000 kw. Expansion calls for raising the dam and installing additional generators.

Atomic-Energy School Opening

U. S. Atomic Energy Commission is now inviting applications for enrollment in the 1951-52 session of the Oak Ridge School of Reactor Technology, beginning Sept 10, 1951 at Oak Ridge National Laboratory, Oak Ridge, Tenn.

The school's purpose is to train engineers in the field of reactor theory and technology. The majority of the problems involve the same fundamental engineering and management skills common to industry. Applications of these skills differ somewhat to fit the needs of nuclear engineering developments. This school offers an opportunity for experienced engineers to learn the particular problems of the AEC program.

Trainees, returning to their home organizations upon completion of the course, can help place their companies in better position to take part in the national atomic-energy program.

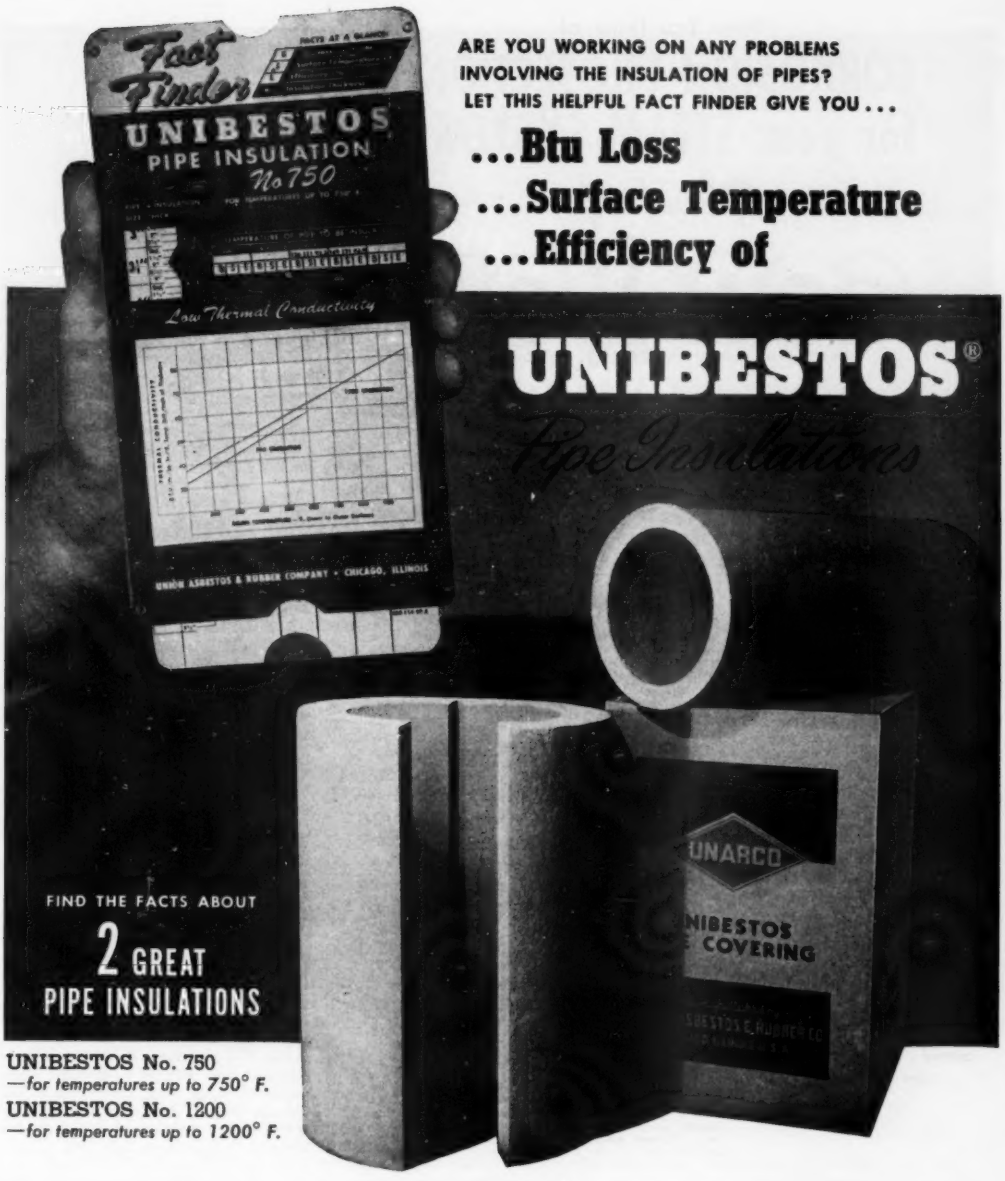
Provision is made for trainees sponsored by government agencies and industrial organizations connected with or interested in the AEC reactor development program to attend school as category B students. Applications must be made by the firms or agencies employing the applicants. The students remain on their home organization payrolls.

Application forms and further information may be had by writing the Director, Oak Ridge School of Technology, Box P, Oak Ridge, Tenn.

The newly formed **Cooling Tower Institute** has as its primary objective the practical encouragement of all efforts, governmental and private, toward conservation of water as America's No. 1 natural resource, according to its president, R C Kelly. It will also try to further cooperative research, coordinate recognized engineering groups in developing standardized testing procedures, establish minimum construction standards.

British Columbia Electric Co will spend $26 million in 1951 on construction and expansion of electric transportation and gas services, a 15% boost over the 1950 capital budget. The new figure will bring the cost of the firm's postwar expansion program to $141,900,000 by the end of 1951.

Electric Energy, Inc, has been formed to build a 500,000-kw electric plant to serve the Atomic Energy Plant at Paducah, Ky. It has been organized by the five par-



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WRITE today, on your company letterhead, giving your title or function. A "Fact Finder" will be sent to you together with complete information on UNIBESTOS Pipe Insulations No. 750 and No. 1200.

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When You Think of

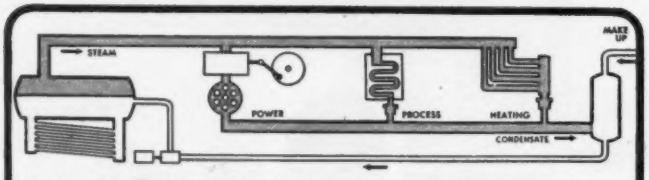
CORROSION PROTECTION for your STEAM SYSTEM

Think of

CORAVOL

(The Original* AMINE PROCESS)

Because CORAVOL Circulates to Control Corrosion



The CORAVOL ZONE—indicated by the shaded area in the diagram—includes every part of a steam system not accessible to boiler feed water treatment. It includes the boiler above the water line, steam lines, condensate return lines, radiators, valves, traps and equipment. This zone can now be reached and protected against rust and corrosive action—by CORAVOL.

CORAVOL IS PART OF A COMPLETE TECHNICAL SERVICE which provides special formulas of chemical treatment for: . . . boiler feed water . . . hot water supply . . . refrigerating brine . . . cooling and condenser water . . . rapid scale removal . . . coagulation . . . algae control . . . fuel oil supply . . . soot removal.

CORAVOL circulating throughout your steam system protects it from corrosive attack. **CORAVOL** saves costly pipe repairs and replacements—maintenance labor—hours and days of shutdown loss. **CORAVOL** cleans out clogging rust deposits, improving heat transfer, restoring original capacity of lines and efficiency of valves and traps.

CORAVOL, the original* amine process, has the flexibility that lets it conform to each individual need. The **CORAVOL** you will use is formulated to do the best protective job under your own plant conditions.

*The use of **CORAVOL** in steam systems is covered by U. S. Patent No. 2053024. The Western Chemical Co., owner of this patent, grants licenses under which volatile AMINES purchased from other sources may be used in steam systems upon payment of royalty to Western Chemical Co.

Chemical Water Treatment

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MAIL COUPON TODAY for
Complete Data about the CORAVOL Process

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Send me full information about CORAVOL.

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STATE_____

ticipating power companies. Officers will be: J W McAfee, president of Union Electric Co, president; Turner White, Jr, superintendent of construction for Union Electric, vice-president; Edgar H Dixon, president of Middle South Utilities, Inc, secretary-treasurer; and E J Shapiro, Union Electric secretary, assistant secretary.

Sweden to Have a 100,000-V DC System

Research has shown that alternating current cannot be used in submarine cables from the mainland of Sweden to Gotland Island, 55 mi off shore. On the island power is generated in steam plants, but it is planned to supply the island from hydroelectric plants over a 100,000-v dc system. At the sending end of the line 130,000-v ac will be converted to 100,000 dc. Then, at the island end, the change will be made from 100,000-v dc to 130,000-v ac.

The line will have only one conductor, sea water will serve as the return. Tests have shown that this system will not harm fish or other sea life. The project, which is the first of its kind in the world, was developed by the State Power Board and the ASEA Co, Sweden's leading electrical-equipment manufacturer. The line is expected to be ready for testing in 1954, but it will require two or more years before regular operation can start.

Alabama Power Co will spend $27,885,000 during this year, the largest construction budget in its history. About half the total will be for construction of new generating facilities. These include completing a 100,000-kw unit at Gorgas No. 2 steam plant, starting another 100,000-kw unit there, completing a 40,000-kw addition to Chickasaw steam plant near Mobile, and work on an additional 55,000-kw unit at Martin Dam on the Tallapoosa River.

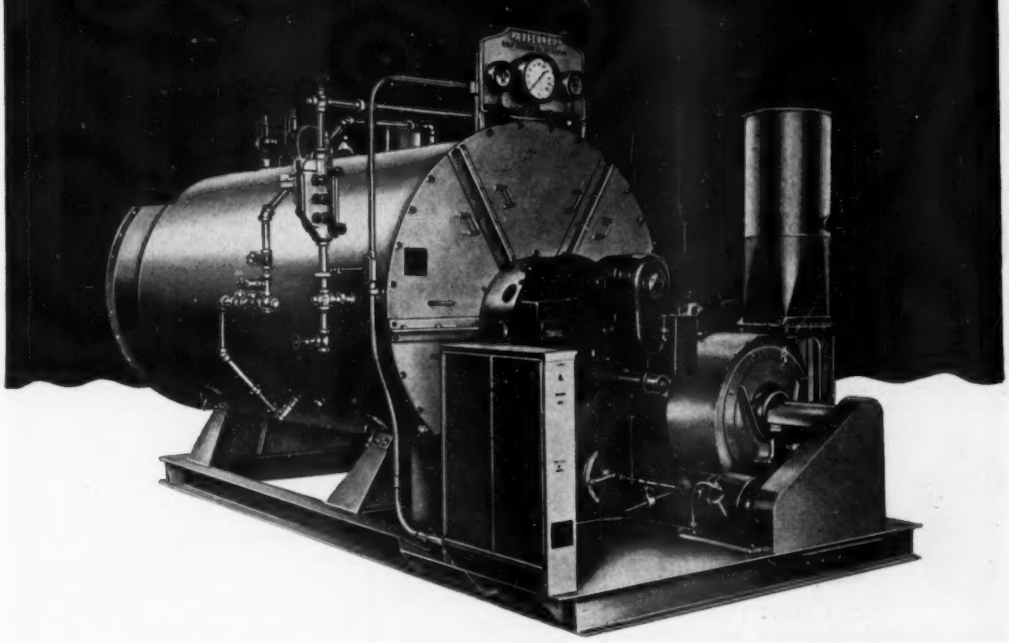
Centennial of Engineering, scheduled for Chicago, September 1952, and sponsored by the American Society of Civil Engineers, has been organized to help the engineering profession tell its story to the public. The program calls for 2-way presentation. One will be a dramatic show presented in the main auditorium of the Chicago Museum of Science and Industry and the other a permanent exhibit in the Museum, to be opened July 1952.

A new 16-mm sound motion picture in color, **Pattern for Survival,** featuring Bill Laurence, science writer of *The New York Times,* runs for 20 minutes, and has been produced with the U. S. Army and Navy and the American Red Cross. It gives realistic and factual procedures for meeting the dangers of atomic blast.

Ohio River Valley Water Sanitation Committee plans to promote investigations toward unmasking unsuspected public-health hazards from traces of pollutants

Still leads the field

PREFERRED UNIT STEAM GENERATOR



IT'S A FACT—the finest unit steam generator costs the least over its entire life span. That's why Preferred has never lowered the quality of its product to lower the first cost. This accent on progressive engineering not only insures Preferred's leadership in its field, but also gives you—the buyer—true boiler economy • Such features as the anti-stress deck, staggered tube construction and special precipitator are your assurances of at least 25 years of efficient, economical, maintenance-free service at a minimum efficiency of 80%.

Write for bulletin giving complete details.

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1860 BROADWAY, NEW YORK 23, N. Y.

Better Drainage at *any* Pressure with Stickle Open Float Steam Traps

Series 100 traps have built in by-pass and strainer. All traps have self-regrinding valve and seat. *Guaranteed* performance. Check this complete line against your drainage requirements—send for *free* bulletins below.

STICKLE SERIES 100

A series of traps with a capacity range of 450 to 4,500 lbs. per hour for drainage of smaller units operating at low, medium and high pressures. Built for straight-in-line installation. See Bulletin No. 115.

STICKLE SERIES AE

A series of traps with a capacity range of 4,500 to 18,000 lbs. per hour for drainage of larger units operating at medium and high pressures. Multiplies old standard capacities by four. See Bulletin No. 315.

STICKLE SERIES 50

This series of Stickle Traps especially designed for drainage of processing units operating at medium to high pressures creating unusually large volumes of condensate. Capacity standard 8 to 10 times that of standard traps. Capacity range 18,000 to 45,000 lbs. per hour. See Bulletin No. 515.

STICKLE SERIES T

A series of traps for drainage of units working at medium and low pressures and to work with vacuum systems. 12 styles and sizes afford a wide range of adaptations and meet a wide range of requirements. See Bulletin No. 415.

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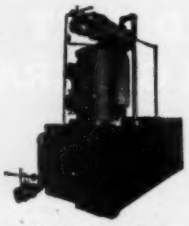
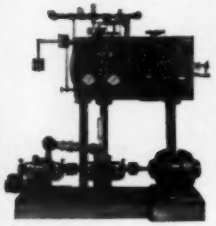
2265 Valley Avenue, Indianapolis, Indiana

other cost-cutting STICKLE equipment



Stickle Open Coil Feed Water Heaters

Stickle Regulating and Reducing Valves



Stickle Differential Drainage and Boiler Return System

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entering streams with industrial and other wastes. High among the materials to be studied are chemical content of brine wastes, material in insecticides, and the wastes from a new atomic-energy installation at Paducah, Ky.

Swedish Transmission Line in Operation

Most of the water-power sites in Sweden are in the northern part of the country, but the industries are mostly in the south. To bridge this gap six 200,000-v transmission lines have been built. The increase in power demand has made necessary transmission at higher voltages. The State Power Board, which is building several large hydro stations in the north, has recently put a 380,000-v line in service.

This is the highest voltage of any long commercial transmission line in the world. It runs 600 mi from the Harspranget on the Lule River, 22 mi north of the Arctic Circle, to Hallsberg in central Sweden. Here the voltage will be stepped down to 200,000 v and tied into the network operating at this voltage. A second 380,000-v line over 300 mi long is to be completed in 1953. A third line at this voltage is to run from Hallsberg to the southernmost province.

Double conductors instead of single ones and large series capacitors for reducing losses are used. Cost of the new line is about $37,000 per mile, or 1.6 times as much as for a 200,000-v line, but it will transmit more than three times as much power.

The Newcomen Medal for "achievement in the field of steam" went to **Isaac Harter**, chairman of the board, **Babcock & Wilcox Tube Co**, at a joint meeting of the Newcomen Society at the Franklin Institute. This was the second time the medal was bestowed, the first being to Rear Admiral Harold G Bowen, USN, in 1944.

South Africa to Get Commercial Synthesis Plant

Construction of the world's first modern, commercial, gasoline-from-coal synthesis plant will start in South Africa within the near future, according to the M W Kellogg Co, refinery and chemical engineers of Jersey City and New York.

The plant, largest industrial project undertaken in South Africa since the last war, is being engineered and built for South African Coal, Oil and Gas Corporation Ltd. It will be adjacent to the Vaal River, near the town of Coalbrook in the Orange Free State, about 40 miles south of Johannesburg.

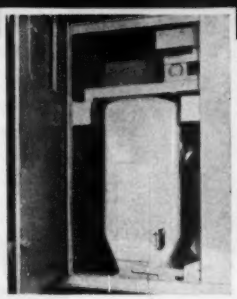
Many years of planning by South African government and private interests went into the decision to build a plant designed primarily to produce liquid fuels—gasoline and diesel oil—*in volume*. While South Africa does not possess any major indigenous petroleum reserves, it does have tremendous deposits of coal available at low cost. Through use of the Kellogg Synthol Process, it is believed these deposits can

Low Maintenance Costs are Assured with S-E-Co. Coal Scales

S-E-Co. Coal Scales assure low maintenance costs because of the rugged construction used throughout. For example, the gear box is a separate, especially designed box for coal scale operation. The electric counter eliminates many small linkages and several adjustments. Electrical equipment is all wired to terminal blocks, simplifying servicing.

A large assembly door and a feeder access door make it possible to remove the feeder and weigh hopper quickly as units. If the feeder support rolls are also removed, the entire inside of the body is free of operating parts. The inside of the scale is then clear for cleaning and painting. If this work is done occasionally, the scale body should last indefinitely.

This subassembly idea has been developed in **S-E-Co.** Coal Scales in order to assure users of the very minimum of maintenance costs.



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715 P HANNA BUILDING • CLEVELAND 15, OHIO

Treat Cooling Water *with Chlorine* — the Proven Way

HELP MAINTAIN MAXIMUM PLANT EFFICIENCY . .

Hundreds of power plants and refineries have found chlorination by W&T the answer to heat exchanger slime problems. By eliminating slime forming microorganisms, maximum heat transfer is maintained in the condensers. The result — overall plant efficiency is kept at a maximum.

REDUCE LABOR COSTS . . .

High labor costs involved in frequent condenser tube cleaning are eliminated when chlorination is employed. Manhours used for tube cleaning can be utilized for other maintenance jobs, an important factor with the increasing manpower shortage.

REDUCE DOWN TIME . . .

Elimination of frequent shut-down for tube cleaning helps power plants stay continuously "on the line." When chlorination is employed, many plants find that outage for cleaning is reduced to once per year and then only for removing trash from tube sheets.

W & T Air Operated Visible Vacuum Chlorinator

Years of operation have proved the dependability and accuracy of W&T Chlorinators for cooling water treatment. Low maintenance and automatic program operation keep operating costs to a minimum. Your W&T Engineer is prepared to make a survey of your plant to recommend the proper chlorination equipment. Write today for more information on slime control — no obligation, of course.

CD-35

WALLACE & TIERNAN PRODUCTS, INC.

CHLORINE AND CHEMICAL CONTROL EQUIPMENT

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be utilized to make the country largely independent in liquid fuels.

High-octane gasoline processes, such as catalytic polymerization, will form a part of the plant facilities. Byproducts of the new plant will be alcohols and oxygenated chemicals suitable for solvents and other uses.

DEMA Summer Schools

Diesel Engine Manufacturers Association has set up three summer schools for professors who teach diesel engineering. These will be held at the plant of cooperating manufacturers. Tentative plans are as follows:

American Bosch Corp, Springfield, Mass., June 18-22: Five-day course consisting of morning technical sessions at which company engineers will speak on various phases of injection practice, afternoons devoted to inspection of plant and work in Bosch service school. This will include instruction in disassembly, assembly, adjustment and calibration of fuel-injection equipment. Enrollment limited to 12.

Texas Co Laboratories, June 25-29: Includes classroom and laboratory work on properties, test methods, manufacture and application of diesel fuels and lubricants. Enrollment limited to 15.

Detroit Diesel Engine Div, General Motors Corp, Aug 20-31: Two-week course covering complete assembly and disassembly of engine and each component. Engine tuneup, diagnosis, dynamometer work and study of multiple units also included. Enrollment limited to 12.

Dr C E Lucke Dies

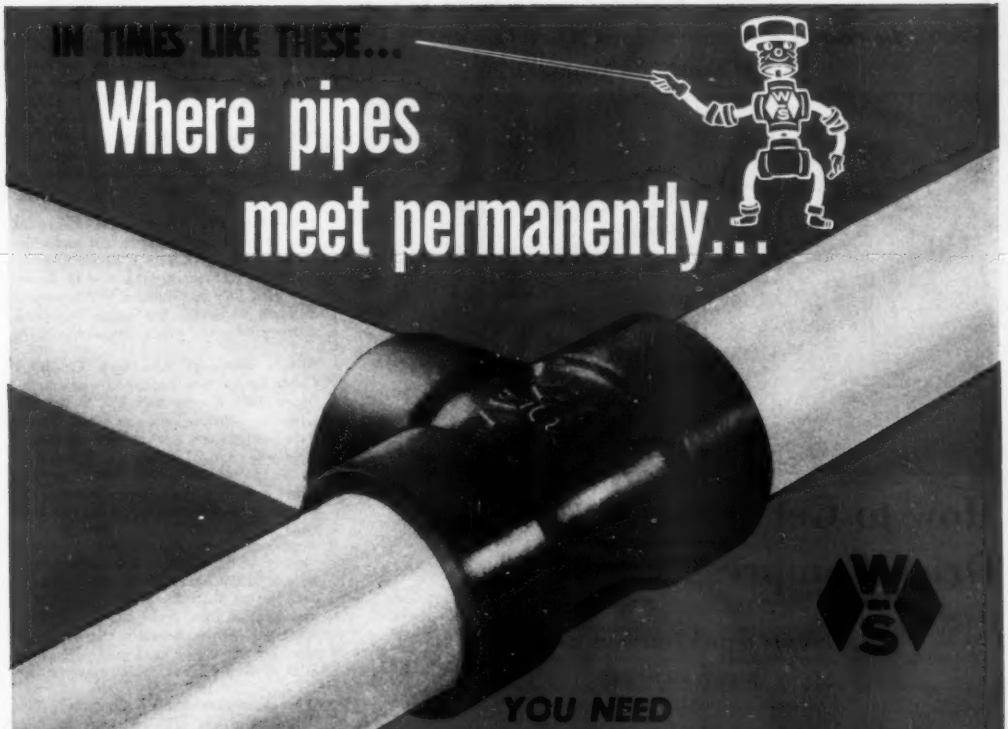
Dr Charles Edward Lucke, teacher, consultant, authority on heat power, died March 25 after a brief illness. He was 74.

Dr. Lucke joined the Columbia University faculty in 1902. From 1907, when he became a full professor, until 1941, when he retired, he headed the ME dept. He was appointed Stevens Professor of Mechanical Engineering in 1929 and at his death was Stevens Professor Emeritus. Present holder of the Stevens chair is Theodore Baumeister, also well known as an authority in the heat-power field.

In his long career, Dr Lucke published four books and more than 75 papers, and secured 120 patents. He acted as consultant to many companies and government agencies.

IN TIMES LIKE THESE...

Where pipes meet permanently...



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FORGED STEEL

SCREWED AND SOCKET-WELD FITTINGS

SCREWED FITTINGS . . . are designed with ample metal sections. The wall-thickness is faithfully observed in final manufacture. Extra long bands extend well beyond the last thread, providing reinforcement at points of severest strain. Threading — is long, accurately cut, and perfectly aligned to insure tight joints. All fittings are properly chamfered to protect thread and afford easy entrance of the pipe.

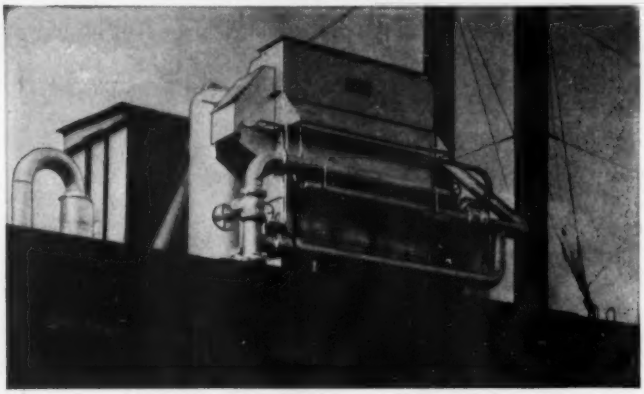
SOCKET-WELD FITTINGS . . . just slip over end of pipe and weld. Deep socket supports and aligns pipe, eliminates tack welding and the use of special fixtures. Accurate measuring and cutting of pipe unnecessary . . . Ample come and go. No welding icicles inside pipe — no clogged lines. Wall sections 1¼ times the nominal pipe thickness permits proper heat penetration and correctly proportioned fillet weld.

Basic materials are selected from a wide choice of carbon, stainless and alloy steels. Drop forging and precision machining makes them light in weight, assures accuracy of finish, and all are instrument inspected for perfection of threads, sockets, angles and concentricity. Write for Bulletin A3-50. For information on Stainless and Alloy Steel Fittings, Bulletin S-1.

DISTRIBUTOR PRODUCTS DIVISION **WATSON-STILLMAN** ESTABLISHED 1848 • ROSELLE, NEW JERSEY

Designers and Manufacturers of Forged Steel Fittings, Valves, Wire Rope Shears, Hand Pumps, Jacks, Pipe Benders and Hydraulic Equipment

Direct saving of cooling water expense returns to you the cost of a Niagara Aero After Cooler in less than two years.



How to Get Drier Compressed Air:

It prevents many troubles and saves much expense

● NIAGARA AERO AFTER COOLER cools compressed air or gas below the temperature of the surrounding atmosphere. Therefore you get no further condensation in your lines. You save much in repairs to pneumatic tools and equipment; you save much interruption to production; you save water damage in paint spraying, in air cleaning, in any process where compressed air comes in contact with your materials or parts in manufacturing (sand blasting, for example).

Niagara Aero After Cooler uses evaporative cooling, saving 95% of your cooling water consumption. This saving quickly returns the cost of the equipment to the owner or makes extra cooling water available for other processes.

The Niagara Aero After Cooler produces compressed air with 30% to 50% less moisture than by ordinary cooling methods. Other Niagara equipment provides bone-dry air for processes requiring it.

If you have an air problem or a cooling problem, a Niagara engineer probably has an answer that will improve your process or save you operating or maintenance expense.

Write for Bulletin 98

NIAGARA BLOWER COMPANY

Over 35 Years Service in Industrial Air Engineering

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Experienced District Engineers in all Principal Cities

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APPOINTMENTS

R W Kimberlin, San Francisco district manager, has been elected to the board of directors of **Graybar Electric Co,** New York. In the firm's Chicago district office, W E Guy has become assistant district manager and has been succeeded by L C Esthus as district sales manager. D M Hitchcock has replaced Esthus as manager in Des Moines.

Johns-Manville Corp elects Leslie M Cassidy chairman of the board and chief executive officer. Adrain R Fisher is president. Cassidy succeeds Lewis H Brown who died Feb 26. William Wilkinson and Kenneth W Huffine are named vice-presidents of sales and production, respectively.

Atlanta offices of **American Chain & Cable Co** are now located in a new building at 1401 Howell Mill Rd, N W. The following district managers will make their headquarters there: C A Goldstrohm; J V Gasso; and J L Filbert. R W Bairstow, territorial representative for American Cable & Hazard Wire Rope divisions, will also make his headquarters at the new location.

Chester W Schweers is named director of sales of **Allis-Chalmers'** general machinery div. Merton M York succeeds Schweers as manager of the New England region. Stanley E Bovim becomes manager of a new branch office in Peoria, Ill., with F D McGuire Jr as sales representative.

Warren Steam Pump Co names Betz Engrg Sales Co, 1225 Magazine St, New Orleans, as its representative in Louisiana, Mississippi, and Alabama, together with sections of Florida and Arkansas.

Daniel F Magner has joined the staff of Machinery Div, **Dravo Corp,** as a sales engineer in the heating dept. He will be stationed in Washington, D. C., with offices in the Dupont Circle Bldg. C H Schofield has replaced M H Stern as service manager of heating dept. Stern has been assigned as sales engineer in Michigan with headquarters in Detroit.

Dowell Inc opens a new district laboratory in Midland, Texas, to operate as a branch of the main chemical research laboratory in Tulsa. James O Means is in charge.

O F Merwin has been elected chairman of the board of **Eriez Mfg Co,** Erie, Pa. R F Merwin has succeeded O F Merwin as president and general manager.

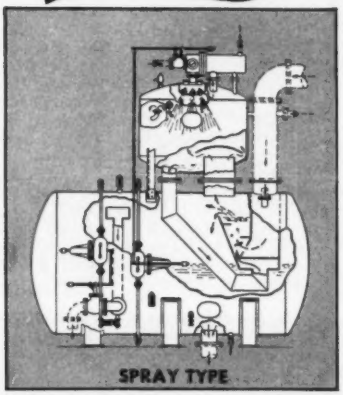
Golden-Anderson Valve Specialty Co, Pittsburgh, announces election of Grant A Colton as president.

Marvin L Cleaton Jr has been transferred to Knoxville, Tenn., as manager of **Foxboro Co's** new branch office as 618 W Church Ave.

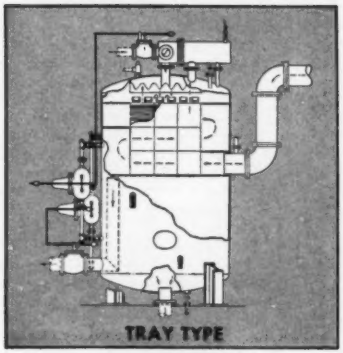
General Electric Co reports the following personnel changes: Elmer F Paul is named manager of manufacturing of specialty transformer and ballast divisions at Fort Wayne, Ind. Concurrently,

Writes this user of a Graver Deaerating Heater...

With 100% make-up water, your unit produces zero oxygen, and this office and the owners are very well pleased with the performance of the unit.



SPRAY TYPE



TRAY TYPE

Here is part of a letter which we recently received from a midwestern engineering firm concerning the performance of a Graver Deaerating Heater installation at a large public institution of which they were in charge.

This spontaneous testimonial is typical of the reports we continuously receive from users of Graver Deaerating Heaters. Whether the units are Spray or Tray type . . . operating on steady or fluctuating loads . . . or with small or large amount of boiler feed make-up . . . a Graver installation can be depended upon to produce zero oxygen and to eliminate carbon dioxide.

Graver's 40 years of experience and pioneering leadership in water conditioning are at your service to solve your water treating problem. Whatever your needs may be, you can be sure of modern, highly effective equipment based on the latest proven developments in water conditioning processes. Your request for authoritative advice and complete information will not involve the slightest obligation on your part.

GRAVER

GRAVER WATER CONDITIONING CO.

Division of Graver Tank & Mfg. Co., Inc.

GW-438

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A SHORT STATEMENT ON

STEAM TRAPS

THAT IS LONG ON GOOD SENSE:

A Steam Trap has but *one* function—to drain condensate from steam lines. Right?

Now if one brand of Steam Trap can drain *twice* as much condensate $ $ = $ under equal conditions, as another of the same size and price—it's just plain common sense to buy that brand, isn't it?

Clark DUO-STEP LEVERAGE STEAM TRAPS have proved in tests time and time again that they *can* drain *twice* the condensate of ordinary traps.

So—do as thousands of smart steam engineers have done:

SWITCH TO CLARK DUO-STEP STEAM TRAPS FOR DOUBLE DRAINAGE EFFICIENCY!

THE CLARK MANUFACTURING COMPANY

1831 East 38th St. • Cleveland 14, Ohio

Clark

THE HOME OF DUO STEP LEVERAGE

The complete line of dependable fluid controls

Donald Poland replaces Paul as manager of the firm's Danville, Ill. plant. William F Oswalt and Frank T Gamec are now assistant manager of manufacturing, and production manager, respectively, of control divisions at Schenectady, N. Y. K O William Sandberg becomes manager of industrial engineering section, Chemical Dept, at Pittsfield, Mass. In addition, Robert R Person is appointed staff assistant to the manager of manufacturing of G-E's large apparatus div. F J Van Poppelen is made general manager of Air Conditioning Dept with headquarters at Bloomfield, N. J. W G Arnold becomes manager of manufacturing of Welding Dept.

Hays Corp, Michigan City, Ind., appoints Orval M Riggs to position of manager, application engineering.

Andrew Kalitinsky, former chief engineer of the NEPA Project, has been chosen by **M W Kellog Co,** New York, as manager of the company's Special Projects Dept.

Minneapolis-Honeywell Regulator Co has increased the industrial field staff of its Brown Instruments Div as follows: Joseph H Matulis has been named manager of Chicago branch, Willard Smith of Pittsburgh branch, and Joseph H Bowman of Buffalo office. In addition, M O Evers has been assigned to San Francisco office; F J Stevens to Los Angeles; W R Coffman, Kansas City; E I Espy, Pittsburgh; R R Stalnaker, Denver; R G Daniels, Washington; C L Griesbaum, St. Louis; D J Nankervis and D J Miller, Chicago; L R Keenan, East Orange, N. J.; P E McKenzie, Louisville; D D Russell, Twin City; E M Corson, Milwaukee; H F Odgen, Dallas; W S Stroud, Knoxville; L D Gercken, Charlotte; H L Kay, Richmond; and J R Morrison, Greenville.

Gordon F Colson is promoted to field engineer for the abrasive div. of **Norton Co.** He will be located in the Chicago area.

Robert C Becherer has been elected vice-president of **Link-Belt Co.** All officers who served last year have been re-elected. Richard Moyer has been made general manager of North Central div with headquarters in Minneapolis, Minn. Fred B Skeates has succeeded Moyer as general superintendent at the Pershing Rd plant in Chicago. Also, Harry G Anderson has replaced J T Bell Jr as district manager at Birmingham, Ala. Bell has been called back into the service of the U. S. Army, Corps of Engineers.

Owens-Illinois Glass Co selects Luse-Stevenson Co, Chicago, as distributor-applicator for Kaylo heat insulation in the Chicago area.

Paul S Shirley joins the Heavy Machinery Div, **Norberg Mfg Co,** Milwaukee, as chief development engineer. Robert P McBride becomes sales engineer. Yaun Equip Co, 2129 N 3rd St, Baton Rouge, as distributor in the southern half of Louisiana.

Raybestos-Manhattan Inc announces that P H Hagen has joined its West Coast

Tyrone, Pa.

Charleston, S. C.

Luke, Maryland

in all these plants of

WEST VIRGINIA PULP & PAPER Co.

Fine papers for almost every purpose—papers that add their persuasive influence to the printed word, beauty to packages and ruggedness for protection; these are West Virginia's products. The Ohio Injector Company considers it a compliment that OIC Valves share in their production.

OIC Valves are *precision engineered* and *precision built,* providing efficient control of flow of air, gases and liquids. And where plant designers and builders need assistance in selecting valves best suited to each use, OIC engineers offer *precision application* help.

Ask your local OIC distributor for a free copy of the OIC Valve Cross-Reference Chart. Or write direct to The Ohio Injector Company, Wadsworth, O.

OIC
FOUNDED 1883

VALVES

FORGED AND CAST STEEL · IRON · BRONZE

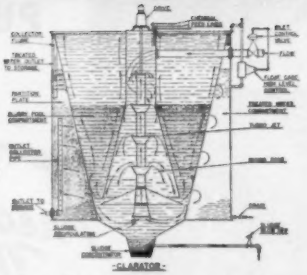
FOR CLARIFICATION, STABILIZATION NEUTRALIZATION, CHLORINATION PURIFICATION, ALKALINITY REDUCTION SOFTENING, SILICA REMOVAL, IRON REMOVAL, CONTROLLED CONDITIONING

The Belco CLARATOR

Advantages:

1. RAPID CHEMICAL SLUDGE CONTACT
2. SIMPLICITY OF OPERATION
3. VARIABLE OUTLET FLOW
4. SEPARATE STORAGE COMPARTMENT
5. COMPACT
6. AUTOMATIC CONTROL
7. LOW TURBIDITY

Looking into Belco Clarator



Essential Components of the Clarator:

1. Raw water inlet pipe
2. Automatic Desludger
3. Central mixing compartment
4. Overflow flumes
5. Turbo-Jets
6. Sludge concentrator
7. Treated water compartment
8. Axial flow slurry recirculation pump

The Belco Clarator is designed to handle all types of water treating problems. Essentially the process design of the Clarator and unit operation is identical for all problems. The differences lie in the type and quantities of chemicals used to achieve a definite treated liquid effluent. The raw water enters the mixing compartment at the top of the Clarator with automatically fed dosages of chemicals so that chemical reaction takes place immediately. Slurry particles rapidly grow in size by accretion and pass to the slurry compartment. The treated water flows around the perimeter of the tank to the outlet. Heavy particles of sludge collect and settle at the bottom of the concentrator where it is automatically discharged.

Complete description and color illustrations in Bulletin 108. Ask for your copy.

Belco engineers are prepared to give you authoritative assistance and close cooperation on all water treatment problems.

Belco

BELCO INDUSTRIAL EQUIPMENT DIVISION, INC.

PATERSON 3, NEW JERSEY

Processes for Removal of Water Impurities

Belco Clarator installed in New York City for clarifying East River water.

sales div to handle the sale of Manhattan mechanical rubber products and R/M packings in the Pacific Northwest with headquarters at 2221-4th Ave, S, Seattle, Wash.

E P Roudebush has become works manager, D A Johann, sales manager, and A E Caudle, assistant sales manager of **Roots-Connersville Blower Corp,** Connersville, Ind.

Charles P Crowley, 711 Gibbons St, Los Angeles, is the new sales engineer for **Reliance Gauge Column Co** in the southern California area.

Swartwout Co establishes a new company-operated sales office at 836 Michigan Theatre Bldg in Detroit. Director of power plant equipment sales for the office, which will service southeastern Michigan, is Kenneth P Hengesbach.

Paul Reeves has been made director of sales for **Timken Roller Bearing Co,** Canton, Ohio.

Leopold Van Blerkon has been appointed assistant general sales manager of Tagliabue Instruments Div, **Weston Electrical Instrument Corp,** Newark, N. J.

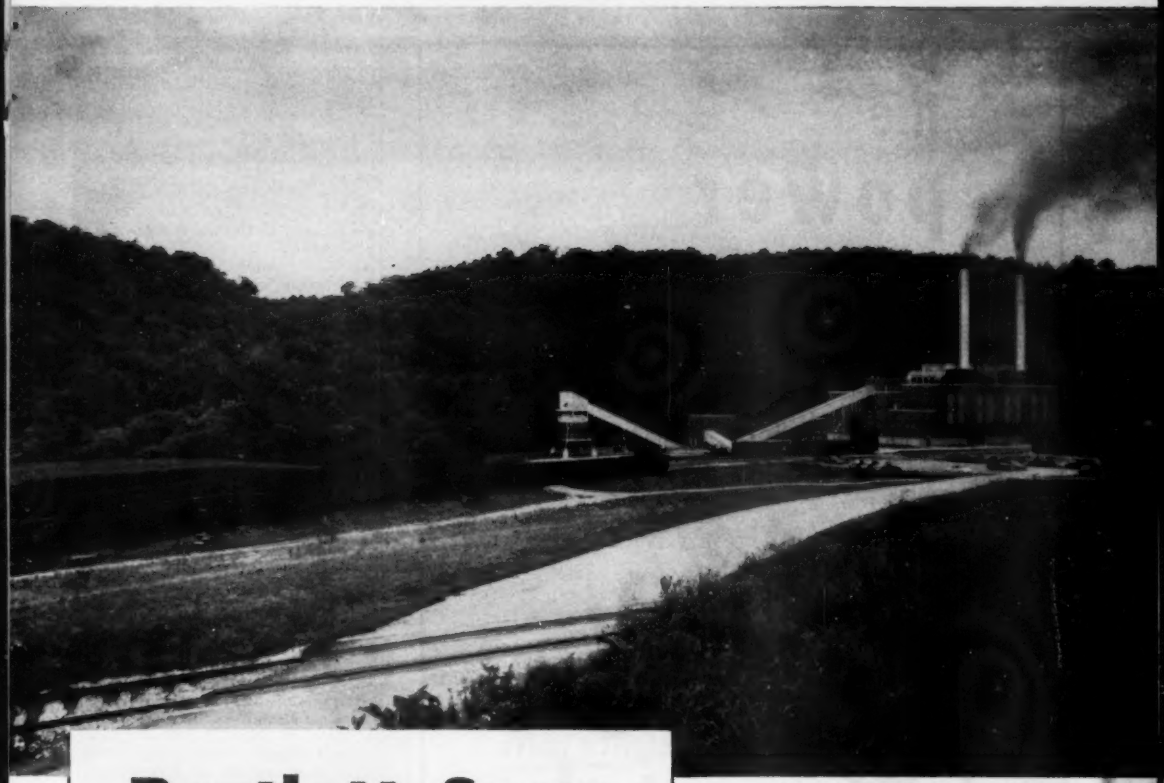
Westinghouse Electrical Corp announces the following personnel changes: Mark W Cresap Jr joins the firm as a vice-president and assistant to Gwilym A Price, president. E C Delano succeeds L E Lynde as manager of New England district with headquarters in Boston, Mass. Lynde, newly elected vice-president, will have charge of the company's government activities in Washington. Wallace B Strathdee is named manager of marine and industrial depts. Henry R Michel is assigned to Washington, D. C. as assistant to Andrew H Phelps, vice-president in charge of purchases and traffic. In the headquarters manufacturing div, W H Dickinson is made director of engineering dept, and G P Longabaugh, director of equipment dept.

Paul B Baird has been advanced to manager of standard pipe sales for **Youngstown Sheet & Tube Co** with offices in Youngstown, Ohio. Baird has replaced Glenn W Christopher who died recently. Carl T Selander has been promoted to assistant manager of standard pipe sales with headquarters in Chicago.

York Corp promotes John L Roth to commercial sales manager of its Central district with an office at 185 N Wabash Ave, Chicago. Territory includes portions of the states of Illinois, Michigan, Indiana, Wisconsin, Minnesota and North Dakota. Rodney F Lauer is now vice-president in charge of engineering and research.

J S Smith has become director of purchases for **Wagner Electric Corp,** St. Louis, Mo.

Lighting sales Central div of **Sylvania Electric Products Inc** has been reorganized into three separate divisions with the following men assigned as sales managers: W J Rashleigh, Chicago div; Paul



General View of Tyrone Power Station
Kentucky Utilities Company
Sargent and Lundy
Consulting Engineers

Bartlett-Snow coal handling at *Tyrone*

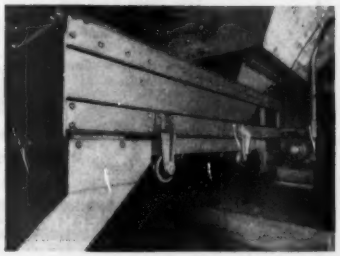
● The illustration above shows the first 50,000 KW unit of a plant which is to be extended into a 170,000 KW station. All coal handling equipment including the track and reclaiming hoppers and grillage, duplex feeder, single plate feeder, conveyors, galleries, surge hopper and all supporting structures were detailed and fabricated in our shops and installed by us to Sargent and Lundy's specifications. For maximum efficiency and fixed unit responsibility, let the Bartlett-Snow coal handling engineers, with their long experience and complete facilities, work with you on your next job.

DESIGNERS
ENGINEERS

BARTLETT-SNOW
CLEVELAND 5, OHIO

FABRICATORS
ERECTORS

Track and Reclaiming Hopper, Crusher House, Stocking Out Conveyor and Storage Yard



Single Plate Feeder Discharging Reclaimed Coal to Main Belt Conveyor System

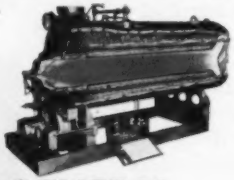
the power of a match

Every fuel and combustion engineer knows that if man could harness the power of but a single match fantastic energy could be obtained. And it is known that control of greater power means savings in manpower, fuel and time.

The Cyclotherm Cyclonic Combustion principle of steam generation is an amazing new step forward in GREATER controlled power.

Boilers are designed for oil or gas operation from 18 thru 500 h.p., 15 to 200 lbs. operating pressure.

Your phone book will give you your Cyclotherm man's address or write for booklet on Cyclotherm Combustion to Dept. M



CYCLOTHERM
STEAM GENERATORS

CYCLOTHERM CORP., OSWEGO, NEW YORK

T Owens, Milwaukee div; and Mules Gaythwaite, St. Louis div. The Milwaukee div will have temporary headquarters in Chicago.

C H Sprague & Son Co, Boston, Mass., appoints Edwin A Stollatis assistant sales manager.

J R Lewis is named assistant general sales manager of **Quaker Rubber Corp,** Philadelphia.

M L Sheehan has joined **Parker Appliance Co** as industrial sales engineer representing the firm in Dallas, Texas, and serving the South Central states. Raymond B Jewett has been chosen to represent the company in Philadelphia, serving eastern Pennsylvania, New Jersey, Delaware, Maryland and Virginia.

Marcus Transformer Co names W D Evan Jr, Pacific Industries, 1046 E Olive St, Los Angeles, Calif., as its sales representative to succeed Robert Young & Co.

Ilg Electric Ventilating Co, Chicago, names Richard I Hanford head of engineering dept. Other appointments include: L E Peterson, head of research div; Elmo Larson, in charge of electrical div; and Fred E Drechsel, in charge of design div.

James H Obear and Walter R Schott have been appointed assistant vice-presidents of **Enos Coal Mining Co,** Indianapolis, Ind.

Everett A Utecht assumes position of assistant chief engineer of **Davey Compressor Co,** Kent, Ohio.

M A Moore has been promoted by **Double Seal Ring Co** to post of Eastern div manufacturing and sales manager at New Rochelle, N. Y.

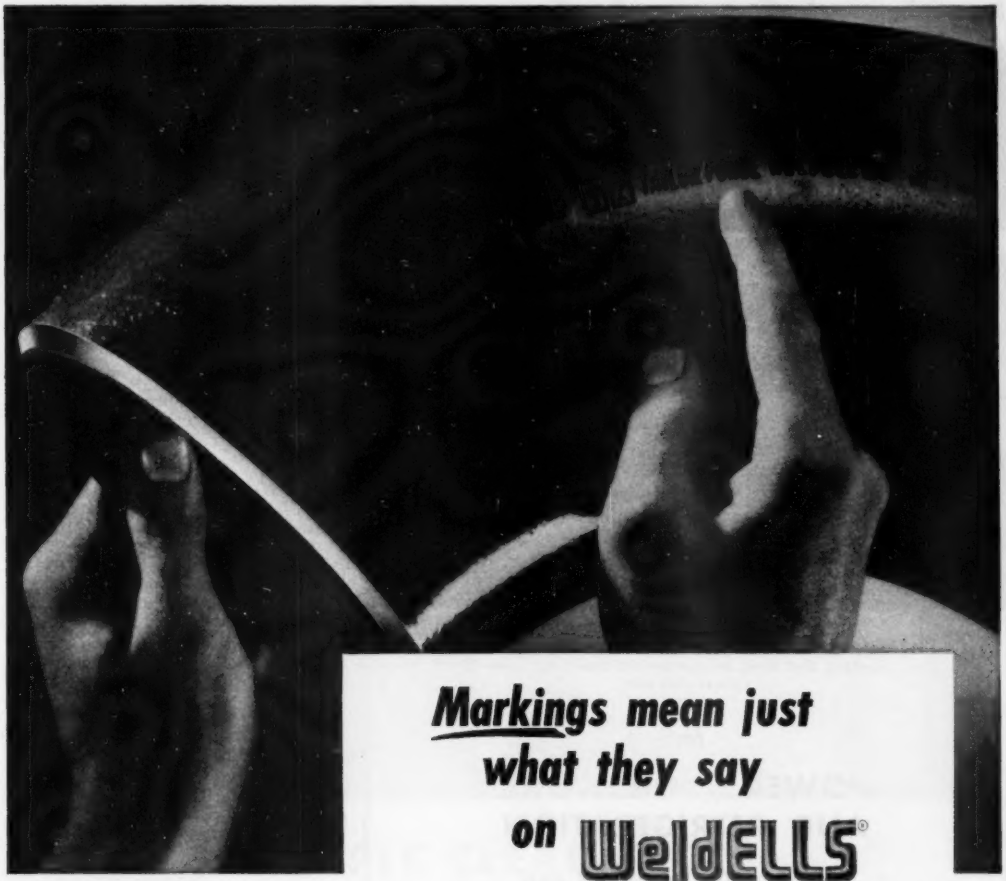
Cummins Engine Co, Columbus, Ind., announces that C B Foster will head a new department of the sales div as manager, contract sales. John W Post is named regional manager of newly created Washington, D. C., region.

Brooks Chemicals Inc is the new name of Brooks Boiler Treatment Co whose plants are located in Cleveland, Ohio and Hamilton, Ont., Canada. Dan J Wilkison is the new president. Other officers are: Fred J Mack, vice-president and secretary; Alfred B Garson, treasurer; and G D Lancaster, chief chemist. Sales and service engineers are: Robert J Anderson for Eastern seaboard and Virginia; Edward E Cazel, western and northern Illinois; George R Goetz, eastern Illinois; and George B Isett, Chicago district.

John R Hartley has been elected a vice-president of **Builders-Providence Inc,** Providence, R. I.

Carl Blom, chief engineer of pump div, **Byron Jackson Co,** Los Angeles, Calif., is now a vice-president of the firm.

Cutler-Hammer Inc announces opening of a sales office at 120 E Third St, Charlotte.



Markings mean just what they say on WeldELLS®

A VOLUME OF USEFUL DATA ON A SINGLE SHEET—Sizes, thicknesses and dimensions of all commonly used WeldELLS and Taylor Forged Steel Flanges ingeniously condensed on a heavy durable, letter-sized card. Indispensable for piping men. Coupon brings free copy.

No other fittings for pipe welding are so true to their markings as WeldELLS — so absolutely uniform, mechanically, metallurgically, dimensionally.

It would be bad business for us to say this if thousands of users had not already said it for us and to us. "There are no bad ones" is nearly always the foremost reason given by practical men for insisting on WeldELLS.

Pick up any WeldELL and check it against the tabulation of its size, wall thickness, and other dimensions. It will be right on the head. And it will be right on the head in plus-value features, too—features that are combined in no other fittings.

Remember that the finest line of welding fittings is also the broadest line. Coupon brings your copy of useful data described below.

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TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS

General Offices and Works: P. O. Box 485, Chicago 90, Ill.
Offices in all principal cities
Plants at: Carnegie, Pa.; Fontana, Calif.; Hamilton, Ont., Canada

Please send a copy of your data sheet covering Taylor Forge Welding Fittings and Forged Steel Flanges.

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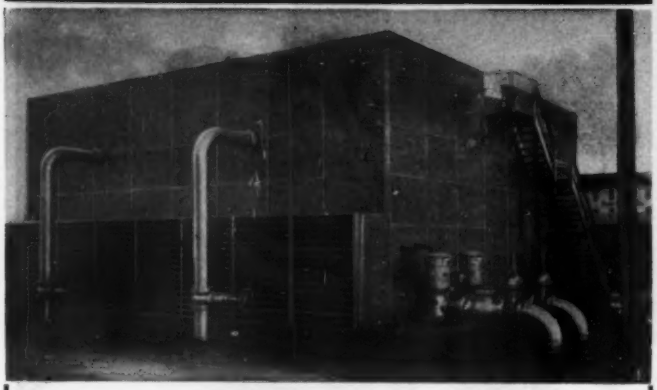
501-0551. Mail to Taylor Forge & Pipe Works, P. O. Box 485, Chicago 90, Ill.

UNITED
COOLING TOWERS



8000 G.P.M. United power plant installation. Transite sheathed, deck filled, low pressure distribution, two double induced draft cells.

for

POWER . . . OIL . . . GAS AND REFRIGERATION

Individually Designed and Constructed in All Mechanical Draft Types

Properly sized to take care of all peak load requirements. Carefully engineered to meet individual cooling problems. Constructed of any specified and mutually acceptable quality materials.

Many United installations now in service. Full details, illustrations, etc., in Bulletin No. 50.

Write for it today.

UNITED COOLING TOWER CO.

Authorized Representatives in Principal Cities

Porter Building Kansas City 2, Missouri

N. C., which will be staffed by Frank A Miller Jr and C Lee Shaw. O P Proudfoot succeeds R J Eckstein as manager of Cleveland district sales office. Eckstein died Feb 14.

Wyman L Wills has been placed in charge of extruded solder sales at the Whiting, Ind. plant of Federated Metals Div, **American Smelting & Refining Co.** Wills has replaced James C Shaw, deceased.

Bronze Bearings Inc, 944 North Ave, East, Cranford, N. J., has been recently organized to take over the manufacture and sale of bronze bearings, bushings, graphited oil-less bearings, and non-ferrous castings formerly produced by S & H Bearing Mfg Co, Cranford.

Dr Victor E Wellsman is named director of process engineering dept of Calco Chemical Div, **American Cyanamid Co,** Bound Brook, N. J.

Burrell Corp has moved its offices and laboratories to new quarters at 2223 Fifth Ave, Pittsburgh, Pa.

Ted L Kelce has become executive vice-president of **Southern Coal Co** with headquarters at 333 N Michigan Ave, Chicago.

Thomas H Haines is named vice-president and associate director of engineering, steam and electric operations, for **Boston Edison Co.**

George F Gant has resigned as general manager of **TVA** effective April 1. John Oliver has been appointed acting manager.

Lieb-Jackson Co, contracting mechanical engineers, assigns Carl N Lohrey as general manager of its Dayton, Ohio branch now located at 743 Valley St.

National Society of Professional Engineers has elected George J Nicastro vice-president in charge of the Northeastern region. He is a sales engineer with Combustion Engineering-Superheater Inc.

Propeller Fan Mfrs' Assn announces election of the following officers for the ensuing year: *President*—Parker T Finch, sales manager, Hunter Fan & Ventilating Co; *vice-president*—B G Krause, manager, Air Controls Inc; *secretary and treasurer*—L O Monroe, Detroit, Mich.

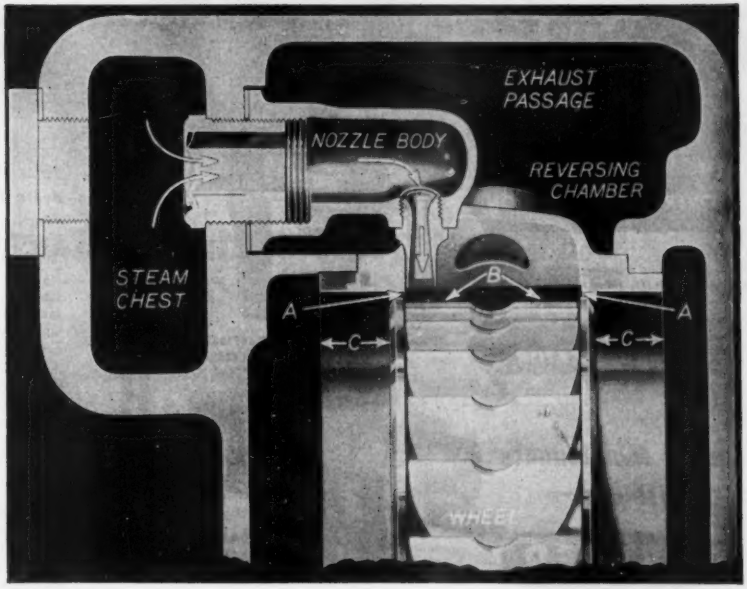
OBITUARIES

Lewis H Brown, 57, chief executive officer of Johns-Manville Corp, for past 22 years, died Feb 26.

Frank A Chambers, 66, long-time secretary and treasurer of the Smoke Prevention Assn of America, died March 21 at his home in Chicago after an illness of 3 months.

Orlo M Crannell, 47, chief engineer of Lynn, Mass. plant of Boston Ice Co, died

TERRY



AMPLE CLEARANCES FOR DEPENDABILITY

Large blade and rim clearances and extra large side clearance — one inch — help make Terry One-piece Wheel Turbines highly dependable in operation.

The blades cannot foul because of the protection afforded by the rims, which are not damaged, should rubbing occur.

Note the rim clearance, AA in diagram. Also the large blade clearance, B. Side clearance, CC, is so large that end-play from external thrust cannot damage wheel.

Terry Bulletin S-116 will give you full information on the Terry Wheel Turbine. A request on your business letterhead will bring you a copy.

T-1171

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

POWERS

No. 11 *Self-Acting* **REGULATORS**

now give you
MORE
for your money

OVER-HEAT PROTECTION

Temperature Adjustment has bronze OILITE thrust bearing

VALVE STEM LUBRICATOR

TEMPERATURE ADJUSTMENT 68° F. ranges available

UNSURPASSED FOR DEPENDABILITY and LONG LIFE

Lower Maintenance Cost and—

BETTER

CONTROLS HEATING OR COOLING MEDIUMS LIQUIDS OR AIR

TEMPERATURE CONTROL

SIMPLIFY your temperature control problems by standardizing on POWERS No. 11 Self-acting Regulators. Use them when you want a simple rugged control to maintain a constant temperature. They prevent OVER-heating, save fuel and labor, pay back their cost several times a year and give years of dependable control.

Backed by over 55 years of experience in self-acting regulators. Engineering service available in over 50 cities.

No. 11 INDICATING REGULATOR has 4" dial mounted on top of regulator. Both thermometer and regulator operate from same thermal system. Visual check on performance of regulator is provided making it easy to adjust for different temperatures. (1185)

TYPES AVAILABLE—Direct and reverse acting regulators with Double Seat balanced valve, double unions ½ to 2" incl., flanged 2½ to 6" incl.; Single Seat valve double unions ¼ to 1½" incl. 3-Way valve ½ to 4" incl. —shown in Bulletin 329. **Use coupon below**

THE POWERS REGULATOR CO., 2771 Greenview Ave., Chicago 14, Ill.

Gentlemen: Please send me Bulletin 329. Am interested in control for

_____

Name_____ Title_____

Firm Name_____

Address_____

April 1, at the Malden (Mass.) Hospital.

Guy A Moffett, 50, assistant manager of engineering of General Electric Co's Control Division at Schenectady, N. Y., died March 27.

Leslie E Sebald, vice-president of engineering, Griscom-Russel Co, died suddenly March 5.

Arthur H Sherwood, 70, Eastern district sales manager, Petro-Chem Development Co, died March 1 at his home in Garden City, L. I., N. Y.

J A Voland, president of Golden-Anderson Valve Specialty Co, died March 10 at his home in West View, Pa.

Swiss Plan Hydro Project

ZURICH (*McGraw-Hill World News*)—Plans have been approved for the construction of a giant reservoir and power stations in the Wallis Canton of Switzerland so as to improve the country's still inadequate supply of power during the winter season. Contrary to the opinion expressed last summer, power supply and demand have failed to reach equilibrium this winter. On the contrary, the general expansion in economic activity during the second half of 1950 and the resultant rapid increase in electricity consumption have created a situation where substantial imports of power are required if the supply to trade and industry is not to be slashed drastically.

Efforts are now being made to increase construction of new power stations. Of special importance is a decision by the Electricity Company "S. A. Grande Dixence" to start work on the first phase of its plan for the Grande Dixence works in Canton Wallis. When this project is completed, Grande Dixence will have a masonry dam 250 metres (820 ft) high and a number of plants that will generate 1.4 billion kwhr during the winter season.

"Summer power" will be produced for the first time in 1952, while winter power generation will start in 1955. Grande Dixence will be of unusual size. Excavation of the foundation for the dam will require removal of 750,000 cubit metres (1,000,000 cu yd). The project has been divided into 14 stages, of which only one will be tackled at first. Consequently, because of uncertain price outlook, it is impossible to estimate the total cost. Previous estimate based on 1948 costs places the investment at 800 million Swiss francs ($186,400,000).

About 16 large power stations are under construction in Switzerland, while arrangements have been made for building 8 more. By 1955, Switzerland's power-generating capacity is likely to be 13-billion kwhr compared to 10-billion at present.

Dismantling of the boiler and steel building of the Union Street steam plant of the **B. C. Electric Company** at Vancouver, B. C., is now in progress. The unit will be transported to Youbou, B. C., and re-erected at the plant of B. C. Forest Products Ltd.

METALLIC AND FIBROUS PACKINGS FOR EVERY PURPOSE

THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.

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THE ANCHOR PACKING CO. TRADE MARK

*Inherently SHIELDED

* The high degree of shielding obtained with the perfected WESTON core magnet mechanism renders Model 901 portables virtually immune to external magnetic fields.

For years instrument engineers have tried to build the magnet inside the moving coil for a more compact, more stable, inherently shielded d-c mechanism. In the Model 901 d-c portable instruments, Weston provides a practical and proved design of this type. The Weston core magnet construction gives uniform flux field over a wide deflection angle . . . withstands extreme mechanical abuse . . . and is exceptionally well shielded without increase in size and with a reduction in weight. Be sure to get the details of this remarkable development from your local Weston Representative, or write Weston Electrical Instrument Corporation, 626 Frelinghuysen Avenue, Newark 5, New Jersey . . . manufacturers of Weston and Tagliabue instruments.

WESTON *Instruments*

New Free Bulletins

(*Continued from page* 168)

B28 **PISTON RINGS**—Thirteen different types of metallic piston rings described. Special features include drawings of typical ring installations in 2- and 4-cycle diesel or gas engines, ammonia compressors, etc. 16-page booklet. Double Seal Ring Co, P O Box 550, Fort Worth, Texas.

B29 **BLAST CLEANING MACHINE**—Describes a portable soft abrasive blast cleaning machine. Also includes an illustrated description of the cleaning of large motors formerly cleaned with inflammable solvents. 4-page bulletin No. 118. Pangborn Corp, Hagerstown, Md.

B30 **CLEANING MACHINE** — Illustrates and describes a line of precision equipment for small parts manufacturing and maintenance. 4-page bulletin. L & R Mfg Co, 577 Elm St, Arlington, N. J.

B31 **SCALE REMOVAL** — Outlines a new process named Crustex, an ultra-sonic wave-producing apparatus for the elimination of limestone crust formations in boilers and pipes. Single-sheet form. Velan Engrg Co, 1 Exchange Place, Jersey City, N. J.

B32 **PLANNED LIGHTING** — Outlines the benefits of good industrial lighting. Describes how to engineer lighting to various industrial tasks, discussing six principal lighting systems, and the use of specific techniques for special needs. 48-page bulletin No. LD-4. General Electric Co, Lamp News Bureau, Nela Park, Cleveland 12, Ohio.

MAINTENANCE MATERIALS

B33 **PROTECTIVE COATINGS** — Construction data and handbook to help solve many problems of hydrostatic pressure, dampproofing, painting, caulking, roofing and flooring. Contents include: construction details, material tables, weights and measures, Horn products and methods. 96 pages. A C Horn Co, Inc, 43-36 Tenth St, Long Island City 1, N. Y.

B34 **SOLVENT DETERGENTS** — Describes the advantages provided by Oakite solvent detergents in effecting removal of carbon, grease, dirt and paint from metal surfaces. 24-page booklet No. F-8143. Oakite Products, Inc, 123 Thames St, New York 6, N. Y.

B35 **FLOOR PROTECTOR** — Discusses the use of Stonhard Stonpach for covering concrete floors to protect them from disintegrating effects of acid, grease, oil, excess water and abrasive wear. 4-page folder. Stonhard Co, Dept P, 1306 Spring Garden St, Philadelphia 23, Pa.

B36 **FLOOR RESURFACER** — Lists application methods of Swift-Floor for resurfacing and repairing. Can be applied over wood, concrete, brick or steel, indoors or out. Form No. 108-11. Monroe Co, Inc, 10703 Quebec Ave, Cleveland, Ohio.

MATERIALS HANDLING

B37 **WIRE ROPE AND CHAIN FITTINGS**—Revised, enlarged data book on industrial and marine hardware. Combines engineering information with extensive catalog of wire rope and chain fittings. Working characteristics, tables and charts included. 44-page catalog No. 150. Thomas Laughlin Co, Portland 6, Maine.

B38 **ELECTRIC CABLE HOISTS**—Describes Bob-Cat heavy-duty electric cable hoists. Illustrated with photos and line drawings of various types of suspensions. Also gives specifications on 1- to 5-ton models and lists lifting capacities, heights, etc. 6-page catalog. Ohio Hoist & Mfg Co, Broadway & Henry Sts, Cleveland 5, Ohio.

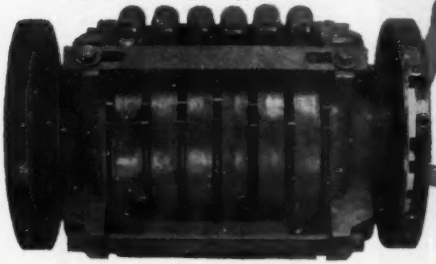
★ **MATERIALS HANDLING** — Collection of seven articles on how aluminum saves manpower and effects other economies in modern handling equipment. 16-page booklet. Aluminum

HERE'S WHY

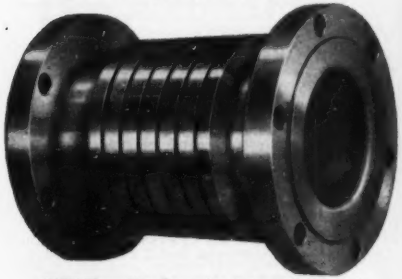
CMH Expansion Joints are preferred by so many piping engineers

- ✓ Space Saving
- ✓ Weight Saving
- ✓ Streamlined Flow
- ✓ Lower Overall Cost
- ✓ Ease of Installation
- ✓ Trouble Free Operation
- ✓ Freedom from Maintenance

CMH Free-Flexing Expansion Joints for pressures to 30 psi; stainless steel or copper; flanges or welding ends; standard sizes to 30" I.D.; larger sizes available for special applications.



CMH Controlled Flexing Expansion Joints for pressures to 300 psi; stainless steel or copper; flanges or welding ends; sizes to 30" I.D.



CMH Flexoniflex Expansion Joints with integral control rings for pressures to 1500 psi; stainless steel and other alloys; standard sizes ⅜" through 6" I.D.; larger sizes also available.

THE PROBLEMS of pipe motion control are reduced to a minimum when you use CMH corrugated type expansion joints. Scientifically formed by advanced methods, they represent the modern, cost-saving, trouble-saving way to control axial, lateral or radial motion in piping or to correct for misalignment.

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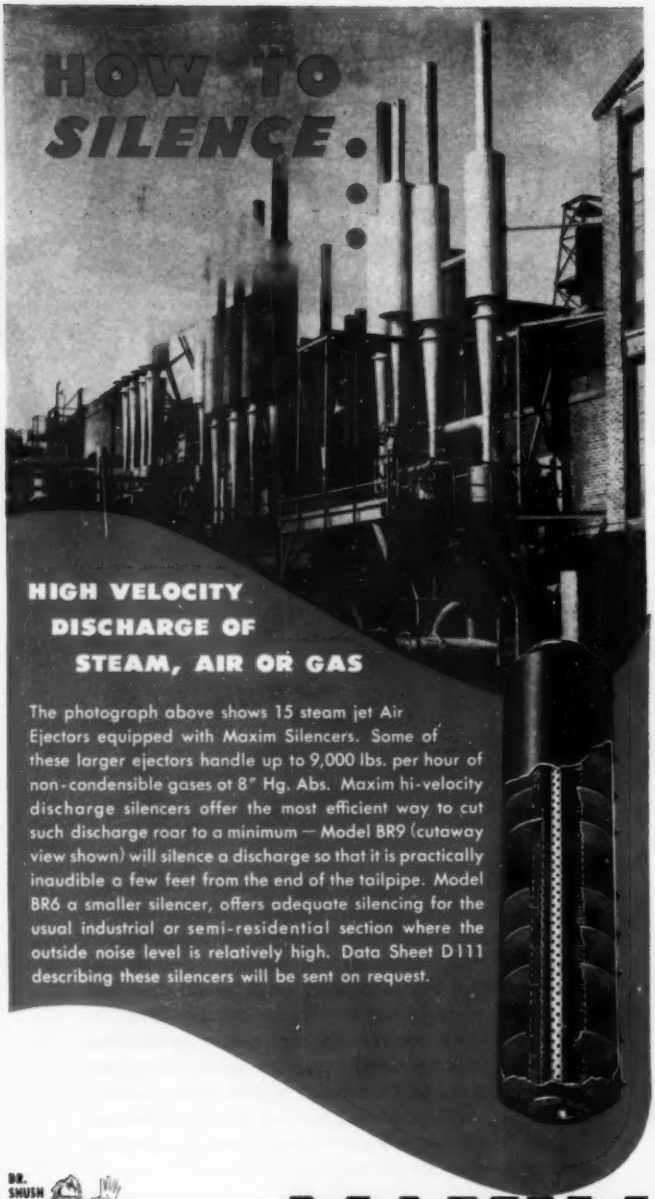

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The photograph above shows 15 steam jet Air Ejectors equipped with Maxim Silencers. Some of these larger ejectors handle up to 9,000 lbs. per hour of non-condensible gases at 8" Hg. Abs. Maxim hi-velocity discharge silencers offer the most efficient way to cut such discharge roar to a minimum — Model BR9 (cutaway view shown) will silence a discharge so that it is practically inaudible a few feet from the end of the tailpipe. Model BR6 a smaller silencer, offers adequate silencing for the usual industrial or semi-residential section where the outside noise level is relatively high. Data Sheet D111 describing these silencers will be sent on request.

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Association, 420 Lexington Ave, New York 17, N. Y. (*Write direct to manufacturer on company stationery giving name and title.)

★ **CHAIN CONVEYORS** — Information on conveyor chains, chain-on-flat and chain-on-edge floor conveyors, and a variety of pusher dogs used in connection with them. 90-page catalog No. 51. Jervis B Webb Co, 8901 Alpine Ave, Detroit 4, Mich. (*Write direct to manufacturer on company stationery giving name and title.)

B39 **MAGNETIC CONVEYOR** — New principles in conveying skelp, plate, sheet, rod, bar, pipe and shapes through the installation of magnetic conveyor elements are illustrated and explained. Typical installations described. 4-page bulletin No. 553. Eriez Mfg Co, Erie, Pa.

MECHANICAL TRANSMISSION

B40 **MECHANICAL COUPLINGS** — Handbook for designers of tension linkages, a term, as used in this book, meaning any chain application in which linear movement of the chain is not continuous in direction. Various types of roller chains used in tension linkage illustrated, described and cataloged. Bulletin No. 51-10. Baldwin Duckworth, Div, Chain Belt Co, Dept PR, Springfield 2, Mass.

B41 **CENTRIFUGAL CLUTCH COUPLINGS**—Gives data on Centric 4-duty Rawson centrifugal clutch couplings. Illustrations, dimensions and advantages are given. 16-page bulletin. Centric Clutch Co, 22-26 South Ave, West, Cranford, N. J.

METALS AND ALLOYS

B42 **STAINLESS TUBING**—Condensed data on analyses, oxidation resistance, thermal treatment and mechanical, electrical and physical properties of the 10 most popular austenitic and ferritic stainless tubing steels. 4-page bulletin No. 19. Babcock & Wilcox Tube Co, Beaver Falls, Pa.

B43 **COPPER BASE ALLOYS** — Describes Lunkenheimer copper base alloys, their manufacture, properties and general application. 16-page brochure. Lunkenheimer Co, Box 360-AA, Cincinnati 14, Ohio.

B44 **CAST STEELS** — Lunkenheimer cast steels, their manufacture, properties and general application described. 16-page brochure. Lunkenheimer Co, Box 360-AA, Cincinnati 14, Ohio.

METERS AND INSTRUMENTS, ELECTRICAL

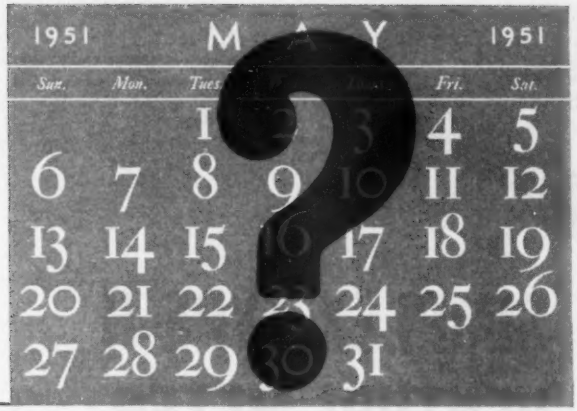
B45 **POTENTIOMETER CONTROLLERS** — Data on multi-record Electronik strip chart potentiometer controllers. General specifications, dimensions and performance charts giving control circuit, rating, application, etc, included. 4-page bulletin No. 189. Minneapolis-Honeywell Regulator Co, Brown Instrument Div, Wayne & Windrim Aves, Philadelphia 44, Pa.

B46 **GROUND TESTING**—Data on Vibroground Model 243 lightweight soil resistivity tester; and Model 263 designed for testing soil resistance, circuit resistance, anode resistance and polarization effects. 2-page data sheet No. 26-43. Associated Research, Inc, 3758 W Belmont Ave, Chicago 18, Ill.

METERS AND INSTRUMENTS, MECHANICAL

B47 **SMOKE ALARM**—Model M smoke density indicator alarm for coal, oil, and gas burning installations described in 2-page bulletin No. 110. One-page bulletin No. 107 includes description, operation, list of materials, and installation information on Model A indicating smoke alarm and recorder. General Power Plant Corp, 381 Fourth Ave, New York 16, N. Y.

B48 **VISCOSITY MEASUREMENT** — Covers Viscorator instruments that provide an instantaneous method for



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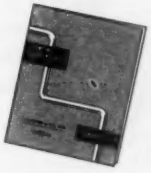

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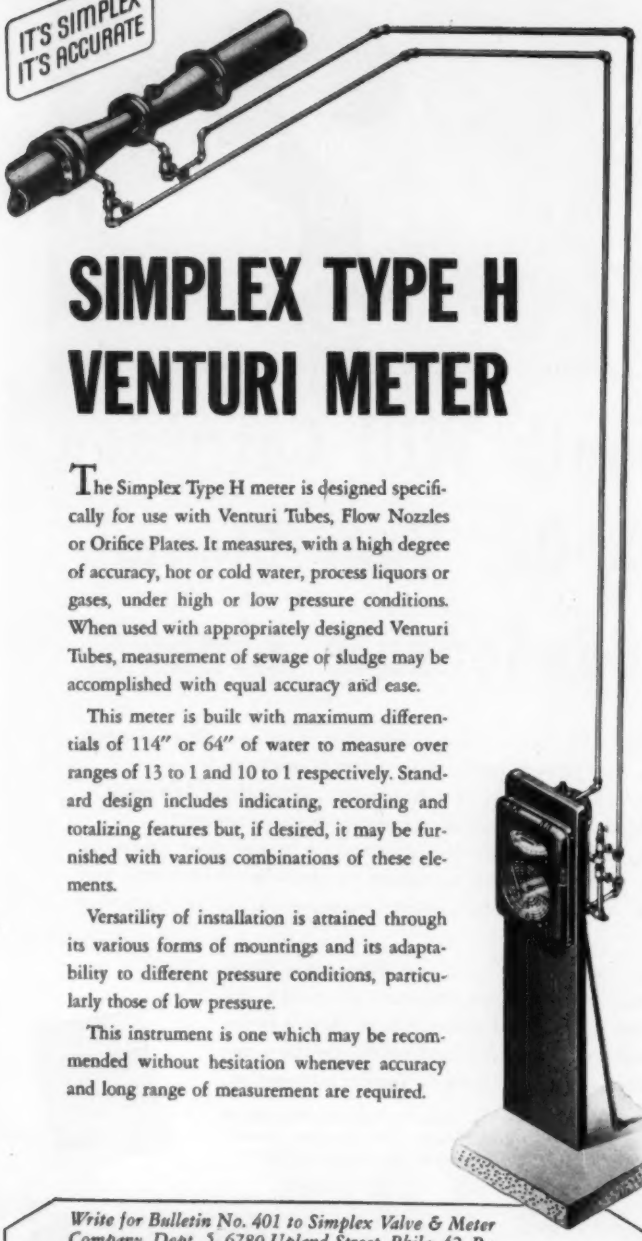

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determining viscosity values for industrial processes. Featured is the Auto-Sampling Viscorator which has a constant differential pressure regulator as an integral part of its design. 11-page catalog No. 85. Fischer & Porter Co, 4030 County Line Road, Hatboro, Pa.

B49 **STEAM AND LIQUID CONTROL** —Illustrations and engineering data on precision pressure regulators, temperature regulators, float valves, strainers, etc. Drawings, layout diagrams, dimensions and capacity tables are included. 56-page catalog No. 51. O C Keckley Co, 400 W Madison St, Chicago 6, Ill.

PIPING, FITTINGS VALVES AND SPECIALTIES

B50 **VALVE PRICE LIST**—Price list, containing information on sizes, materials of construction, of the Jarecki line of valves including bronze and iron valves and cocks, iron and brass unions, expansion and swing joints. 8-page bulletin. Jarecki Valve Div, H K Porter Co, Inc, Drawer 2650, Tulsa, Okla.

B51 **SAFETY VALVE** — Contains detailed information on the Ross safety valve. Cross sectional view and installation data included. 4-page bulletin No. 304. Ross Operating Valve Co, 120 E Golden Gate, Detroit 3, Mich.

B52 **CAVITATION RESEARCH** — Describes cavitation-pitting tests that were conducted to solve some of the problems of cavitation and to determine the relative resistance to pitting of recently developed materials and techniques for applying these materials. 20-page bulletin No. 02B7581. Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee, Wis.

B53 **NEEDLE VALVE**—Entire line of Kerotest forged steel union bonnet needle valves for high pressures and corrosive services described. Several advantages and price list given. 4-page folder. Kerotest Mfg Co, 2525 Liberty Ave, Pittsburgh 22, Pa.

B54 **PLANT PIPING SUPPORTS** — Complete line of pipe hangers and sway braces described. Load-deflection charts given. 6-page catalog No. 502. Bergen Genspring Corp, 15 Park Row, New York 7, N. Y.

B55 **HYDRAULIC STANDARDS** — Incorporating all recent changes and additions, a new edition of "JIC Hydraulic Standards for Industrial Equipment" is now available. 16-page booklet. Miller Motor Co, 4027 N Kedzie Ave, Chicago 18, Ill.

B56 **PIPE-LINE FILTERS**—Describes, illustrates and gives applications and specifications for 75 pipe-line filters including pressure and vacuum types, for air and other gases. 8-page bulletin No. B-1A. Dollinger Corporation, Rochester 3, N. Y.

B57 **BIN VALVES**—Data on Twistite double-closure bin valves for handling lump and fine materials. Illustrations and diagram given. Sheet No. 254-A. Stephens-Adamson Mfg Co, 274 Ridgeway Ave, Aurora, Ill.

B58 **STEEL PIPE**—Covers Spang CW steel pipe and manufacture. Includes black and galvanized pipe in all standard sizes from ⅛- to 4-in., with tables of dimensions, weights, test pressures, threading data, and bundling schedules. 32-page bulletin No. 370. Spang-Chalfant Div, National Supply Co, P O Box 298, Pittsburgh 30, Pa.

PUMPS

B59 **HORIZONTAL PUMP** — Describes and illustrates Peerless Fluidyne pumps which are of the horizontal, end-suction centrifugal type for general purpose service. Parts lists, dimensions and capacities included. 22-page bulletin No. B-2300. Peerless Pump Div, Food Machinery Corp, 301 West Ave 26, Los Angeles 31, Calif.

B60 **VERTICAL CENTRIFUGAL PUMPS**—Features Deming multi-stage high pressure vertical centrifugal pumps designed for use where the liquids being handled are non-corrosive to

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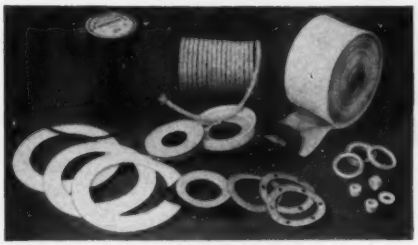

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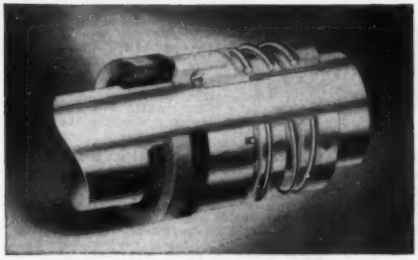

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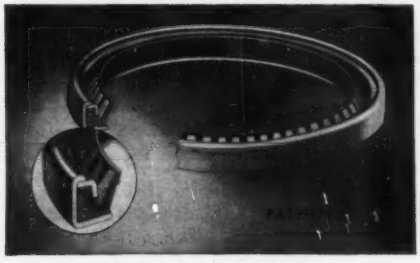

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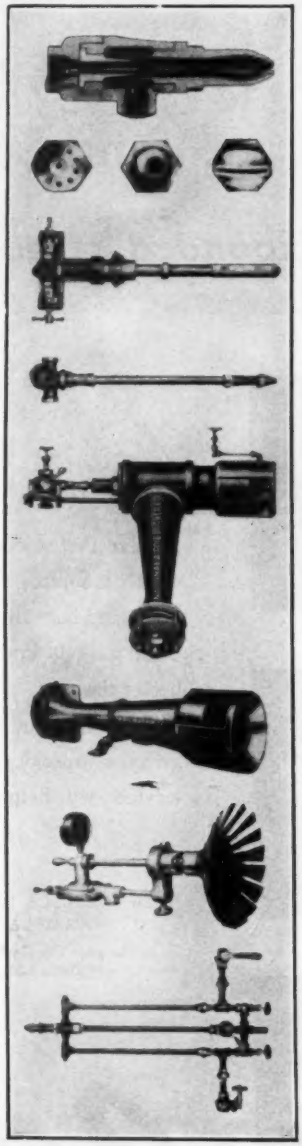

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iron and bronze. Specifications, dimensions, and performance rating given. 2-page bulletin No. 6606. Deming Co, Salem, Ohio.

WATER TREATMENT

B61 HYDROGEN ZEOLITE—Data on Cochrane hydrogen zeolite softeners. Complete description of the process and the field of application, showing the advantage of hydrogen zeolite softening and its relation to the sodium zeolite softening process. 16-page bulletin No. 4530. Cochrane Corp, 17th St & Allegheny Ave, Philadelphia 32, Pa.

B62 WET WATER—Brochure entitled, "Wet Water—what it is and what it can do for you," is a layman's description of current industrial applications of wet water and the Aquadyne system of making an economic supply available without elaborate equipment. 8 pages. Aquadyne Corp, 220 E 42nd St, New York, N. Y.

B63 ZEOLITE SOFTENERS—Explains the sodium zeolite softening process and includes a definition of terms, and description of siliceous zeolites and non-siliceous zeolites. Bulletin No. 4520. Cochrane Corp, 17th St & Allegheny Ave, Philadelphia 32, Pa.

WELDING

B64 WELDING ALLOY — Reprint, "Aircromatic-R Welding of Copper Base Alloys," covers a general investigation into the weldability of several copper-base alloys with the newly developed inert-gas-shielded metal-arc welding process. Illustrated with 45 application and specimen photographs and charts. Form No. ADR 69. Air Reduction. 60 East 42nd St, New York 17, N. Y.

B65 RODS AND ELECTRODES—Consumers price list of Amsco welding products for hardfacing and repair, such as welding rods, electrodes, and weldments. 6-page folder No. W-1. American Brake Shoe Co, American Manganese Steel Div, Chicago Heights, Ill.

B66 ALLOYS AND FLUXES — Wall-chart designed to aid in selecting the particular All-State welding, brazing, soldering, cutting or tinning alloy and flux to best serve the job at hand. All-State Welding Alloys Co, Inc, 273 Ferris Ave, White Plains, N. Y.

OTHER EQUIPMENT

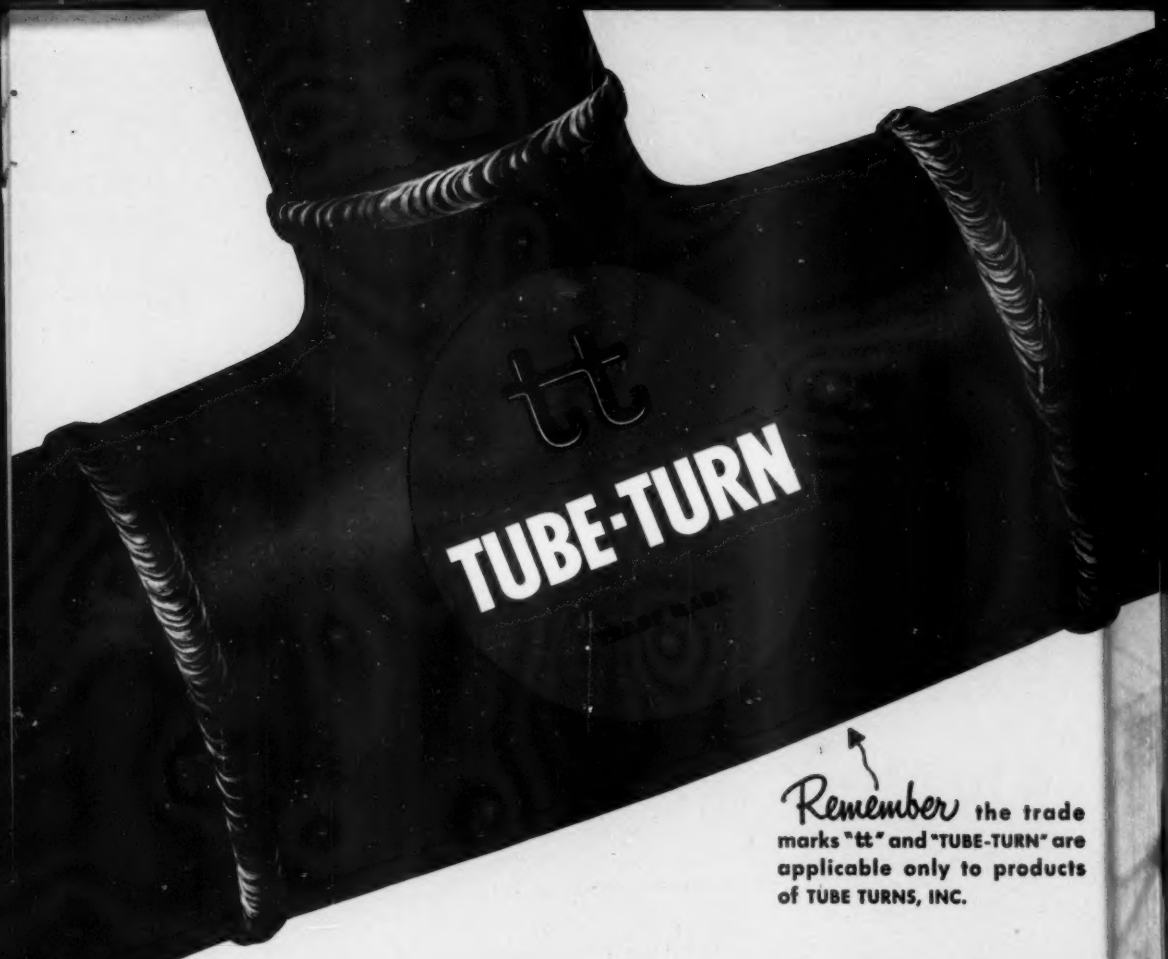
B67 WEIGHING SCALE — Illustrates and describes the new Howe 77 Weightograph, an automatic weighing accessory which can be attached to any scale convertible to beam operation, thus making it automatic. 4-page folder No. 668. The Howe Scale Co, Rutland, Vt.

B68 CONTRACTING SERVICE—Gives a history of Sauer Inc, a firm of mechanical contractors specializing in contracting for plumbing, heating, ventilating, air conditioning, process piping, and boiler plants. 36-page brochure. Sauer, Inc, Pittsburgh 14, Pa.

B69 FOUNDATION STRUCTURES — Types and applications of drilled and poured foundation structures pressure grouting, drainage, de-watering, shoring and sub-surface soil exploration are illustrated and described in case history fashion. 20-page brochure. Casey & Case Foundation Co, P O Box 151, Maywood, Calif.

B70 VIBRATION ISOLATORS — Discusses structural features of all-metal vibration isolators employing no organic material and unaffected by extreme temperatures. Unit mountings, for direct attachment to equipment, and standard size mounting bases also described. Catalog No. 509. Barry Corp, 700-5 Pleasant St, Watertown 72, Mass.

B71 LOW SPEED ALTERNATORS — Describes several of the company's diesel-engine alternator installations with single units ranging in capacity from 125 to 2000 kva. Also included is a list of the company's offices in the U.S. 8-page bulletin No. 510. Ideal Electric & Mfg Co, Mansfield, Ohio.



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PIPING PERMANENCE is always important but now, more than ever, any installation of piping should be leakproof, maintenance-free and have extra long life. A piping system, big or small, is only as strong as its weakest component. That's why welding fittings, for example, should be specified with care.

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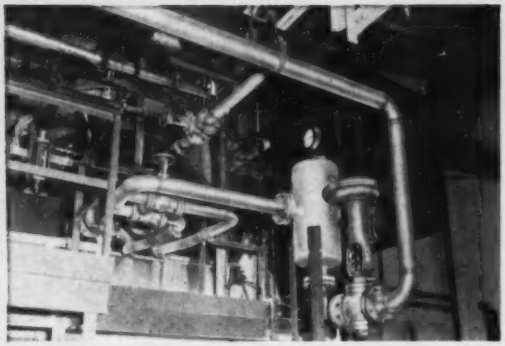
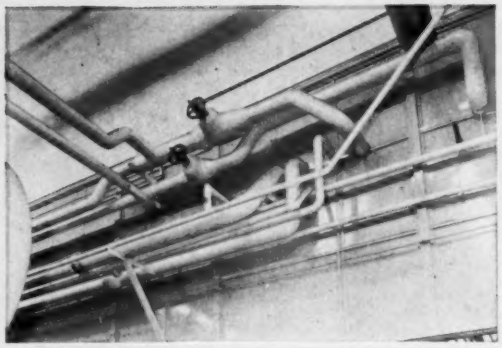
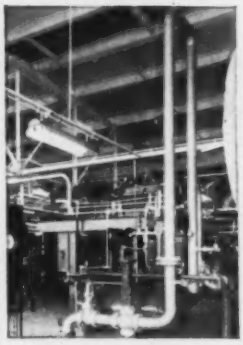
Penicillin processor welds stainless steel piping ½" and up



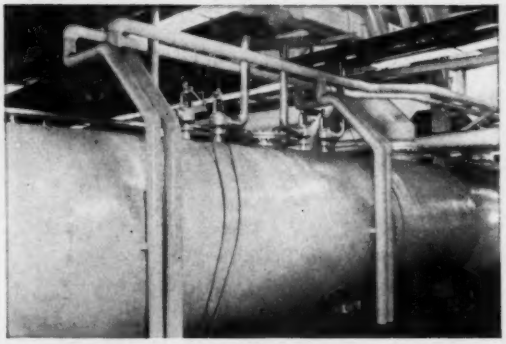
Advanced facilities in plants and laboratories help Eli Lilly and Co., Indianapolis, turn out a high volume of pharmaceuticals, biologicals, and antibiotics. This new filtration unit in the penicillin processing system uses 3" and 4" Type 316 stainless steel—chosen to resist corrosive action. Welded system with TUBE-TURN Welding Fittings and Flanges was chosen to provide maximum strength and eliminate leakage.



Neat appearance of insulated lines demonstrates simplicity of welded piping. Insulation was applied quickly over pipe and TUBE-TURN Welding Fittings, with no awkward joints to work around. Maintenance men know that insulation will last, with no leakage to cause deterioration. Cleanliness and neatness are prime requirements in Eli Lilly plants.



Up in the air goes a loop welded with 6" pipe, joined with TUBE-TURN Welding Fittings and Flanges. Structural strength here is a must. In this fermentation tank where life-saving penicillin is made, tiny lines of ½", as well as larger sizes, are welded. Comparable modern facilities are provided for making streptomycin and other products.



Lines to process vessel fit neatly into a small space when TUBE-TURN Welding Elbows make the turns. Eli Lilly engineers specified process piping for optimum flow conditions, compactness, and elimination of leakage.

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1. **Permits rapid equalization of temperature differentials** because it has a thermodisc seat. Minimizes thermal stresses, prevents distortion, achieves permanent tightness.
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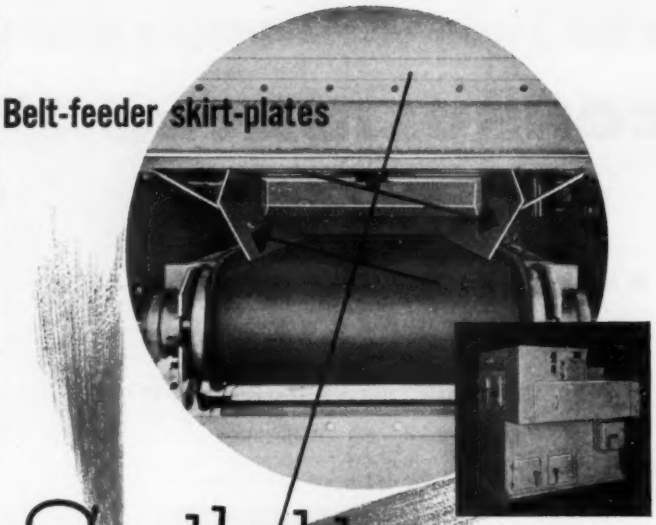

Spotlighting DURABILITY in the RICHARDSON coal scale

Another reason why thousands of power installations keep an accurate check on boiler efficiency with Richardson Automatic Coal Scales.

Developed to increase dependability and accuracy, Richardson Belt-Feeder Skirt-Plates are designed to guide the coal on the belt. Sloped inward to take part of the load off the belt, these Skirt-Plates increase belt life and reduce power consumption. This design feature maintains full efficiency with either wet or dry coal. Clearance between the belt and the bottom of the Skirt-Plate increases in the direction of belt travel, eliminating the possibility of coal jamming. For maximum protection against corrosion, Richardson Skirt-Plates are made of a high-chrome stainless steel.

Some of the other features that make Richardson Scales the standard of comparison throughout industry are:

QUICK-RELEASE BY-PASS MECHANISM for emergency re-routing coal direct to stoker or pulverizer.

HINGED LEVELING PLATE to establish a uniform "breakaway" of coal each time the feeder belt is stopped, and to allow passage of occasional large lumps without damage to belt.

DIRECT-CONNECTED DISCHARGE COUNTER to register automatically and unerringly the number of discharges.

ALL ELECTRICAL EQUIPMENT mounted outside of corrosive atmosphere of coal chamber.

3 BULLETINS AVAILABLE

Send For Them Today For Complete Information On: EE-39, for dust-tight, average service—200-300 lbs. per discharge—**Bulletin No. 0150.**

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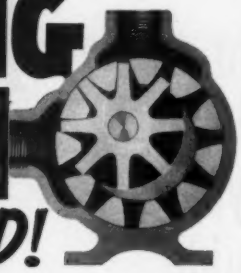

Just as Viking means rugged warriors, so does Viking stand for rotary pumps that are rugged. Designed and built for service, Viking pumps have proved dependable and long-wearing.

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With screwed or socket weld ends. 3000-lb. and 6000-lb. service.

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Here are a few reasons why Spence Regulators give you accurate regulation and long, trouble-free life:

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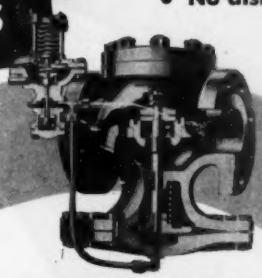
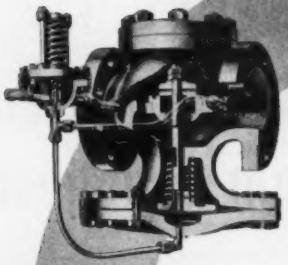
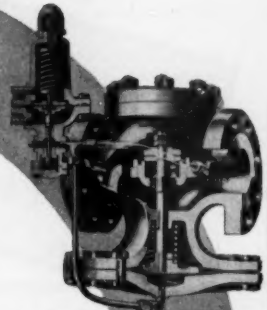


PRESSURE REDUCING—Self-operated, dead-end regulators powered by large, frictionless, metal diaphragms. Sizes ¼ in. to 12 in. Pressures to 600 psi 750 F.

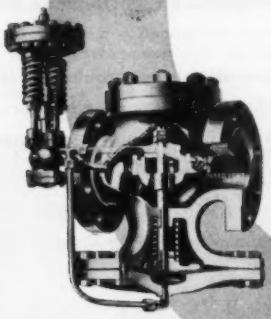


BACK PRESSURE CONTROL—Wide selection of sensitive pilots to meet exacting requirements. Initial pressure closing, guaranteed to shut tight. Packless construction, metal diaphragms.

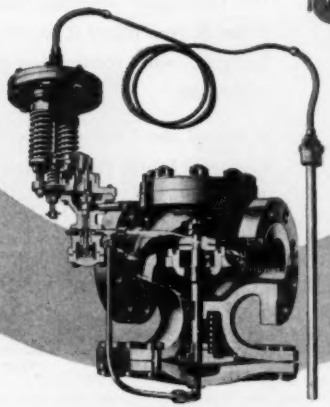
WRITE FOR BULLETIN 350
for complete details on Spence's line of automatic regulating valves



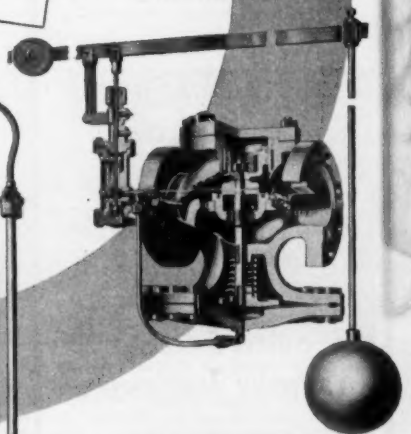
DIFFERENTIAL PRESSURE—Accurate control of delivery pressure at a constant, adjustable differential from 3 to 150 psi above another source of fluid pressure.



PUMP GOVERNOR—Constant or excess pressure control for steam pumps. Steam pressures to 600 psi 750 F, pump discharge pressures to 2000 psi.



TEMPERATURE REGULATING—Combined temperature and pressure control. No separate reducing valve required. Shuts tight, will not wiredraw or be damaged by overheating. Sizes to 12 in.



LEVER OPERATED—Pilot lever for connection by cable or mechanical linkage to floats or other devices. Slight actuator motion opens and closes main valve.

BE-113

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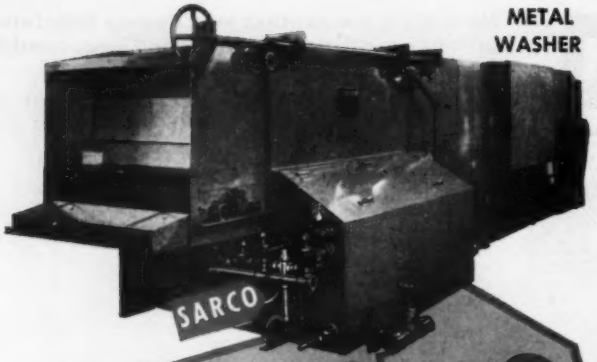
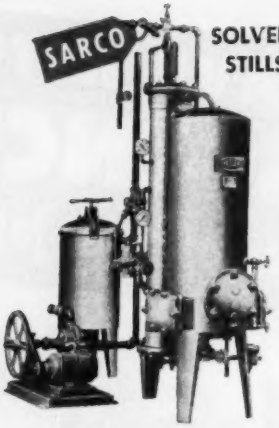


METAL WASHER



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Why is it that more than 100 manufacturers of steam operated machinery prefer to equip with Sarco steam traps, temperature controls or strainers before the equipment is shipped? The answer is simple. After years of tests in their plants and in the field they know that their machines will produce more with less steam and fewer service calls.

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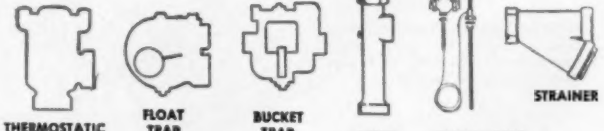

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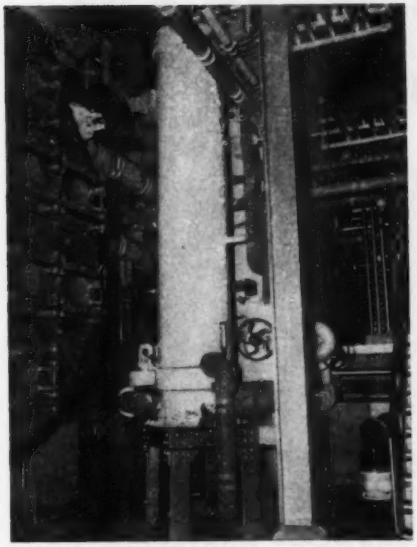
SARCO SAVES STEAM
IMPROVES PRODUCT QUALITY AND OUTPUT

CONSECO Contributes...

to PUERTO RICAN ECONOMIC PROGRESS



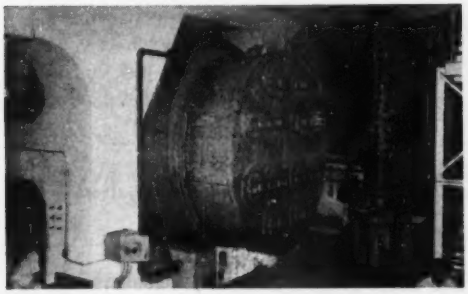
Intermediate and High Pressure Feed Water Heater for Unit No. 1. Both heaters operate with 1200 psig in water passages and have integral de-superheating and drain cooling sections.

WHEN the new San Juan Steam Plant is completed, CONSECO will have furnished the following equipment:

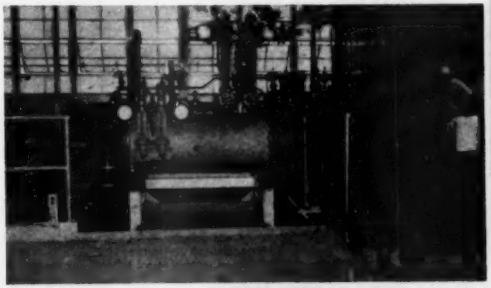
- 2 20,000 sq. ft. CONSECO two-pass divided flow Condensers for Units Nos. 3 and 4.
- 2 twin element two-stage CONSECO Steam Jet Air Ejectors for Units Nos. 3 and 4.
- 4 834 sq. ft. CONSECO high pressure Heaters. Forged steel heads are of the shear ring design with integral tube sheets. For Units 1, 2, 3 & 4.
- 4 834 sq. ft. CONSECO intermediate pressure Heaters. Forged steel heads are of the shear ring design with integral tube sheets. For Units 1, 2, 3 & 4.
- 2 single stage non-condensing hogging Ejectors for Units Nos. 3 and 4.

As of this time, Units Nos. 1 and 2 are in operation. Unit No. 3 will be on the line by September 1951. Unit No. 4 presently being fabricated.

Selection of CONSECO equipment for this new power plant is evidence of recognition of CONSECO'S competent engineering as well as responsibility for meeting performance guarantees. Every day dependable service of CONSECO equipment in hundreds of plants is a matter of record. Send for illustrated Engineering bulletins covering CONSECO Condensers, Feed Water Heaters, Evaporators, Deaerators, Boilers, Steam Jet Air Ejectors and Refiner Filters.



CONSECO Condenser installed ready for final painting and Feed Water Heaters ready for application of insulation. Unit No. 3.



One of the two Twin Element CONSECO Air Ejectors in this new Puerto Rican power station serving a 20,000 sq. ft. CONSECO Condenser. Each unit is complete with pressure reducing valve, socket-welded steam piping and CONSECO thru-type Air Meter. It is one of the largest power plant type ejectors to be equipped with combined inter and after condensers. Air Ejector shown serves Unit No. 3.

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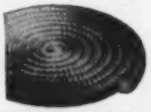

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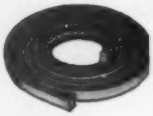

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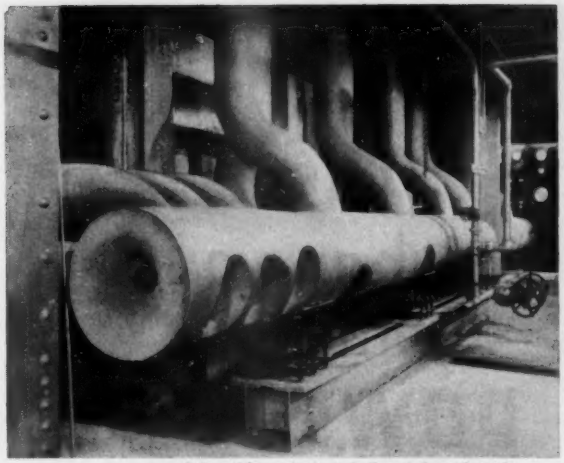

Boiler and furnace header in the Riverside Power Plant, Lake Charles, La., of the Gulf States Utilities Corporation, Beaumont, Texas. **Insulation Contractor:** Armstrong Cork Company.

Whatever your heat insulation problem, you'll find a Keasbey & Mattison covering that will solve it better. Consider the two K&M Insulations used in the above installation, for instance:

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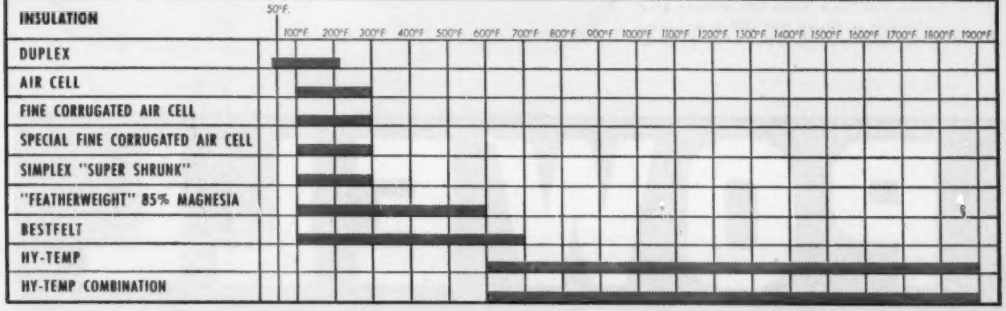

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Fig. 16013 W.E. Class 600-pound Cast Steel Pressure Seal Gate Valve with welding ends and by-pass equipped with 600-pound Steel Integral Bonnet Angle Valve—Fig. 1535-A

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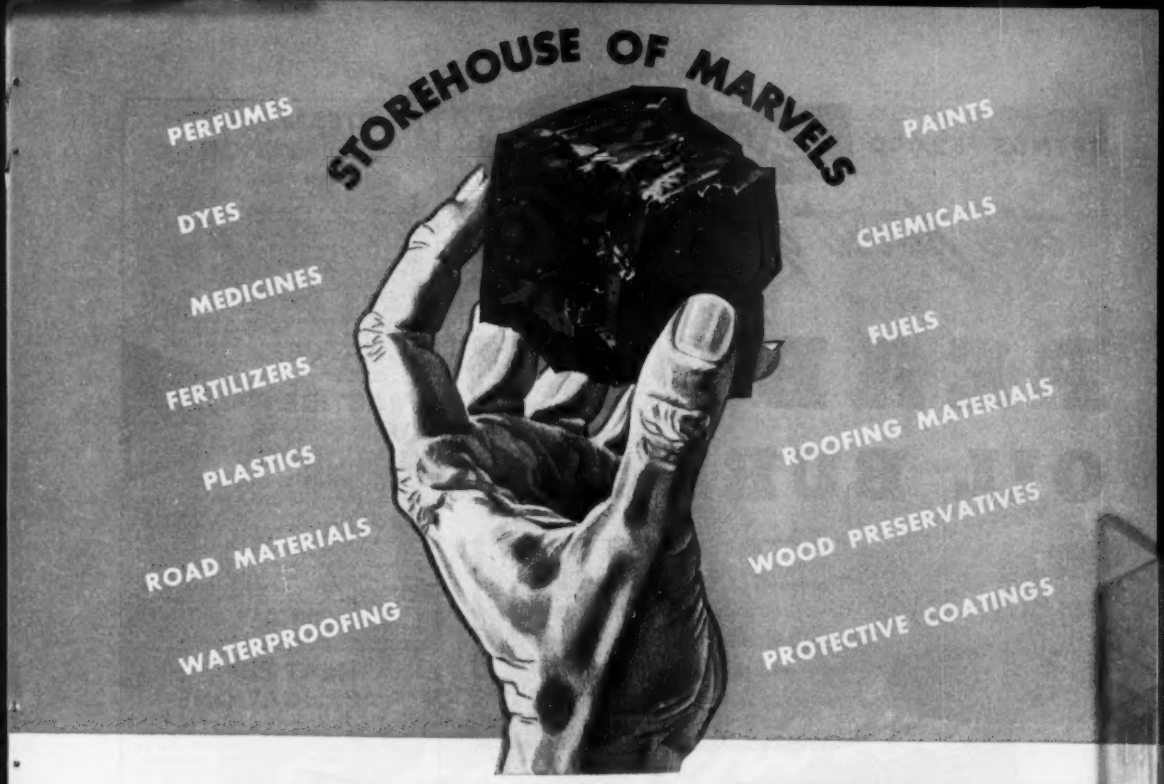

...but the greatest marvel of all is its *HEAT!*

It's amazing to think of such things as perfumes, fertilizers, dyes and medicines, coming from a lump of coal.

But it's even more amazing to consider the things that come from a lump of coal when it's put into a firebox . . . and burned! From this one source . . .

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. . . heat and power for tens of thousands of commercial, institutional and industrial establishments in the populous eastern area is produced,

. . . twenty-five thousand steam locomotives still on the rails huff and puff and move the nation's freight.

Then, of course, there is the major contribution that coal makes to the manufactured gas industry—a vital utility in many sections.

Coal can be stockpiled more readily than any other fuel. It is less likely to be affected by diversion—created shortages in periods of emergency. Virtually limitless resources eliminate any long-range fear of depletion. Beacon Coal offers added advantages. The fifteen Beacon coals are mined from fields famous for quality. Each offers desirable special properties that plus its performance. We'll be glad to talk to you about supplying your requirements.

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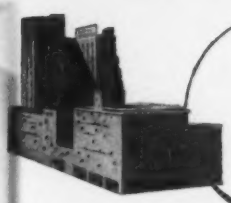

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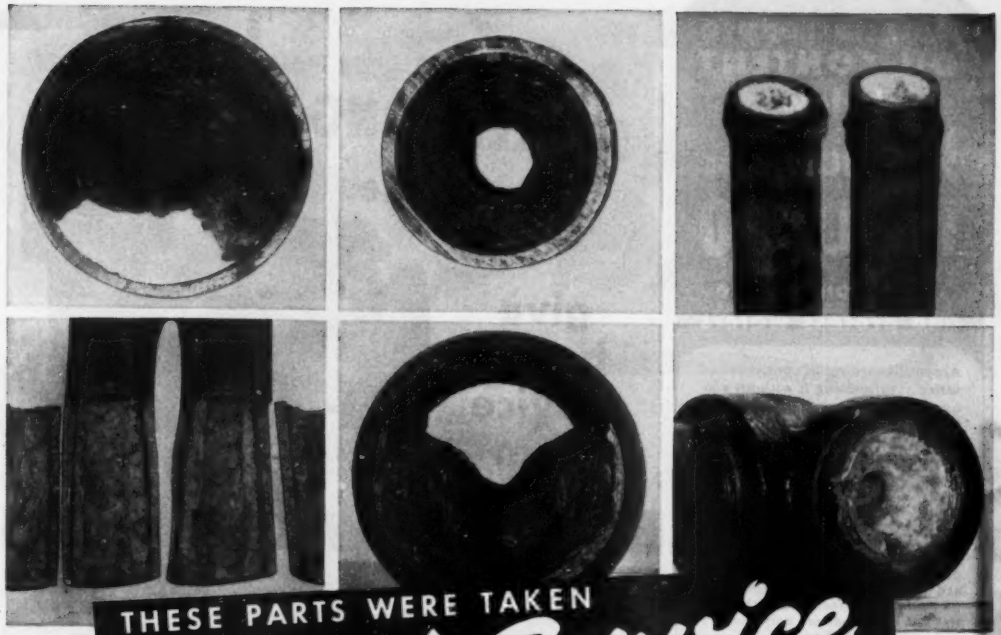

THESE PARTS WERE TAKEN

Out of Service

BECAUSE OF SCALE

DEARBORN FORMULA 134 REMOVES SCALE

● These destroyed parts represent a large, unnecessary investment in equipment, labor and shut-down time. Conditions like these can easily and economically be avoided with Dearborn Formula 134. Wherever water travels—scale tends to form. Formula 134 is a concentrated solvent for the rapid removal of scale in heat exchange units, boilers, pumps, feed lines, meters, condensers and other valuable equipment.

Formula 134 is just one of many Dearborn formulas used to save equipment, reduce shut-down time and maintenance costs. Other Dearborn formulas control acidity of condensate, prevent excessive foaming and prevent corrosion of metal in contact with calcium and sodium chloride refrigerating brines. For the correct water treatment to best meet your needs—consult Dearborn.

SAFE, SIMPLE APPLICATION

with specially designed, inexpensive pump also supplied by Dearborn! Send for Bulletin 5002 which describes in detail methods for the removal of scale with Dearborn Formula 134.

AFTER APRIL 16, OUR NEW ADDRESS WILL BE:

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Merchandise Mart Plaza • Chicago 54, Illinois

DEARBORN CHEMICAL COMPANY
Merchandise Mart Plaza
Chicago 54, Illinois
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Gentlemen:

Please send me information on Dearborn Formula 134.

Name.....

Company.....

Address.....

City.....State.....

Dearborn

TRADE MARK REGISTERED

THE LEADER IN WATER TREATMENT AND RUST PREVENTIVES

How to reduce OIL CONTENT below

1/10 part per 1,000,000

. . . in condensate and process waters

Are you discarding oil-contaminated water . . . or re-using it without adequate purification? If so, you may find filtration with Sorbo-Cel a relatively simple, inexpensive solution to your problem.

Easy, low-cost clarification . . .

Sorbo-Cel is a specially processed diatomite powder. Used in conjunction with any standard screen-type filter unit, it provides a fast, easy and inexpensive way to absorb emulsified oil and other impurities from water. Total processing costs (including both material and operation) are only from 1¢ to 3¢ *per 1000 gallons.*

How Sorbo-Cel works . . .

A small amount of Sorbo-Cel is simply mixed with the oil-contaminated water, which is then pumped through the filter. Here the oil globules are removed by the specially treated Sorbo-Cel particles, and both are retained upon the filter screen. The filtered water alone passes through. Oil removal is virtually complete—less than 0.1 ppm remaining.

Other important advantages . . .

In addition to trapping out oil globules, Sorbo-Cel filtration removes suspended solids such as rust, scale, and clay. Boiler-tube life is increased, scale formation is reduced, and shutdowns are less frequent. In plants using graphite or wet-steam lubrication to keep condensate oil-free, this method permits a return to the more efficient oil lubrication—with resultant economies in ring wear.

For further information about Sorbo-Cel filtration, use the coupon below.

JM

Johns-Manville
SORBO-CEL®

Johns-Manville
Box 290, New York 16, N. Y.
Send me free bulletin giving advantages of Sorbo-Cel filtration.

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Company _____
Address _____
City _____ State _____
POW-5

These EVERLASTING advantages give better service from

Fig. 4001/6561. Duplex unit consisting of Straightway Lever-operated Sealing Valve and Angle Blowing Valve.

BOILER BLOW-OFF VALVES

When you install an EVERLASTING Duplex Blow-Off Unit, you'll find that its many superiorities speak for themselves.

The sealing valve at the left is the EVERLASTING design that has been famous for more than 40 years . . . the valve with the drop-tight seal that actually improves with use because of its self-lapping action each time the valve is opened or closed . . . the valve that can't stick or jam because of its non-wedge design . . . the valve that opens in less than a quarter turn to provide unimpeded straight-through blow.

The blowing valve at the right is the equally famous EVERLASTING Angle or "Y" Valve, specially designed and equipped to withstand repeated blow-off shocks, erosion and corrosion, and without pockets that might trap and hold solids.

Each of these valves . . . and all the other EVERLASTING Boiler Blow-Off valve types, fully meet ASME code requirements . . . assurance that they are properly designed and amply strong for the service.

Write for descriptive bulletin

EVERLASTING VALVE CO.
49 Fisk Street, Jersey City 5, N. J.

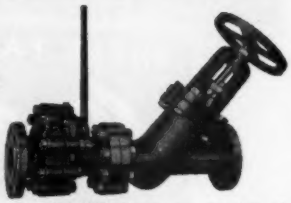


Fig. 4001/6571. Duplex unit consisting of Straightway Lever-operated Sealing Valve and Y Blowing Valve.

Fig. 6571/6561. Duplex unit consisting of Y Sealing Valve and Angle Blowing Valve.

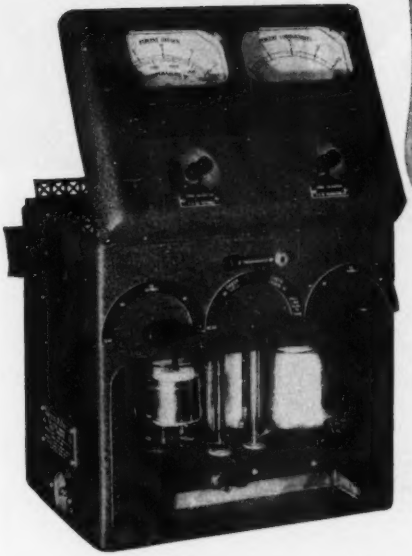
Fig. 6561/6571. Duplex unit consisting of Angle Sealing Valve and Y Blowing Valve.

Everlasting Valves

TRADE MARK "EVERLASTING" REG. U.S. PAT. OFF.

EV-349

FOR EVERLASTING PROTECTION



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Combustion Facts Fully Revealed by Fast, Simple Heat Prover Test

This scientific combustion analyzer—the Cities Service Heat Prover—gives you the real "inside" on furnace combustion conditions. Its plain, quick, accurate work lets you know:

How much excess oxygen is present

How much combustible matter is wasted

How much fuel you might save

Without endless trial-and-error you can proceed to conserve fuel and increase furnace output. This is substantiated by records made on all types of furnaces. See for yourself how productivity can be improved. Call or write *today* for a Cities Service Heat Prover demonstration... readily arranged in your plant. Or for further details return the coupon below.

Not an instrument you buy, but a service we supply. Write or call us today.

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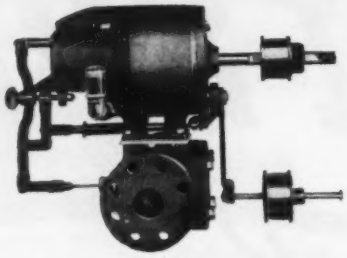
Providing Better Speed Control and Wider Speed Ranges for Steam Engines



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- Up to 6:1 speed range
- Fully enclosed, self-oiling
- Ball bearings; no gears
- Manual or Remote Control
- Very precise in its setting
- Setting holds regardless of load and steam pressure fluctuations
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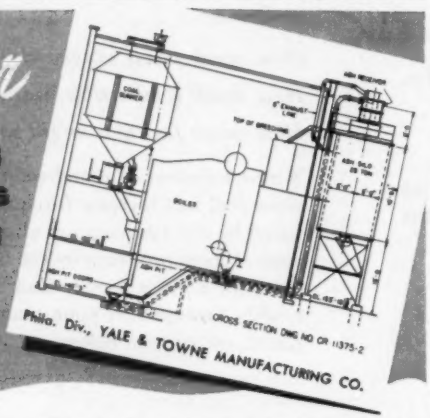
2500 RAILROAD AVENUE TROY, PENNSYLVANIA
Established 1870

Another COAL and ASH HANDLING INSTALLATION by BEAUMONT



Here's one of the many efficient coal and ash handling installations—designed, manufactured, installed by Beaumont. The above system is operating at the Philadelphia plant of Yale & Towne Manufacturing Company. This plant saved both time and expense—through one-contract-economy . . . But you're right! It's up to us to convince you of the advantages in a Beaumont installation: So let us send you our folder of typical installations. Write to:

Beaumont BIRCH COMPANY
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HOW are other plant engineers handling today's problem of maintaining efficiency of air conditioning equipment? What short-cuts are proving successful in conserving water — saving operation expenses through effective maintenance cleaning?

In this new booklet you will find the answers to those and such other problems as . . .

- Controlling Slime
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Then, too, there is valuable information on maintenance cleaning of such allied equipment as . . .

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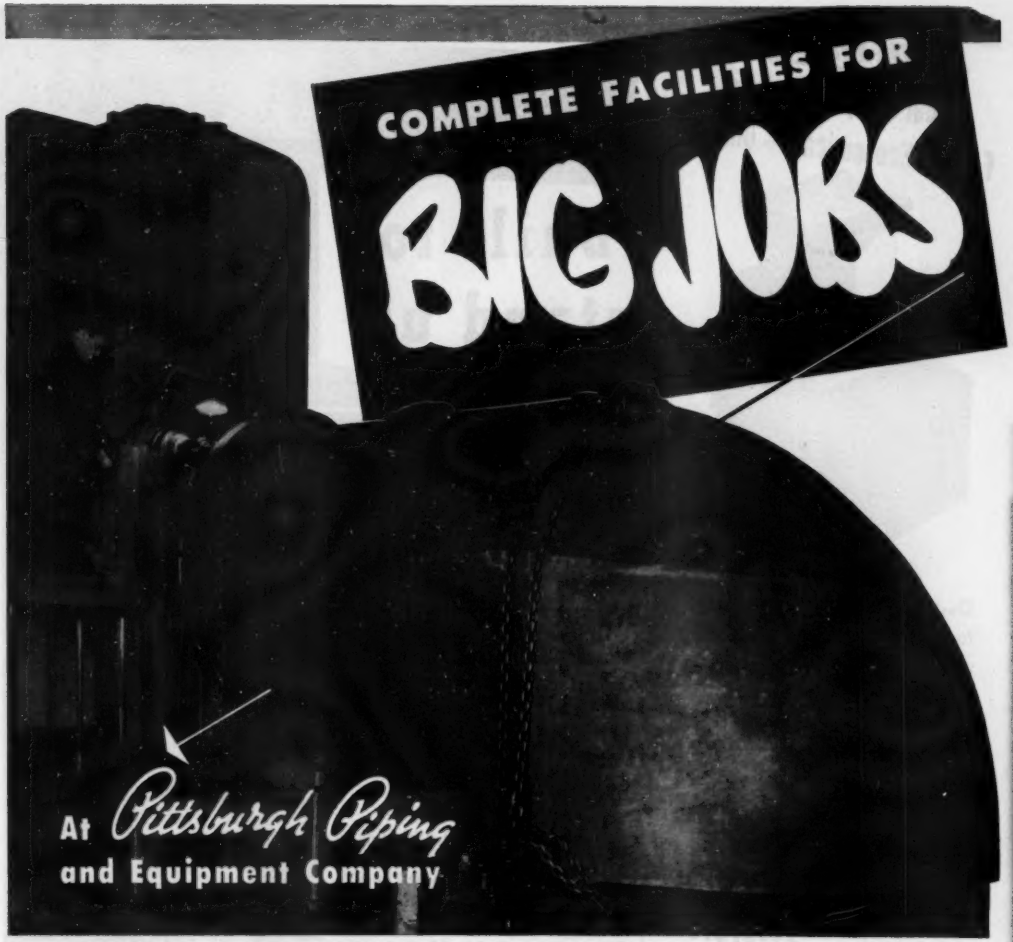

Machining a casting of this size requires special equipment—big equipment for handling big jobs.

Actually, this casting is small compared to the complex piping systems that are planned, prefabricated, and tested *under one roof* at Pittsburgh Piping and Equipment Company.

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Because our manufacturing personnel and equipment are all under the roof of one great plant—our complete know-how, experience, and facilities are constantly available on every job.

This is another reason why you can depend upon Pittsburgh Piping and Equipment Company for service that provides greatest safety, highest efficiency, and longest life from high temperature, high pressure piping.

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Holmes

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Designed to crush coal samples for testing. Produces samples of uniform size consist for constant and accurate analysis. Holmes' Laboratory Crushers feature easy accessibility to crushing chamber for cleaning, replacing hammers, and changing screens. Rubber seals eliminate dust leaks. High crushing rate, low initial and operating costs are outstanding.

Simplified — Accurate Coal Sample Grinding with Holmes Pulverizers

Dustless operation. Rugged and compact construction with quick opening feature for easy cleaning. None of the sample is lost. High grinding rate with negligible over-size material. Even, constant feed maintained by easy-turning screw-feed. Grinds 20-mesh material down to small micron sizes.

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Snap-on tools *must* have *everything* it takes, in right design, right steels, right manufacture... and *direct-to-industry distribution.*

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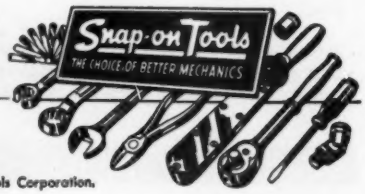
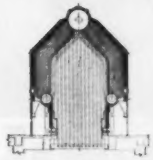


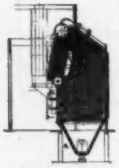
*Snap-on is the trademark of Snap-on Tools Corporation.

If you need steam you need a Wickes steam generator

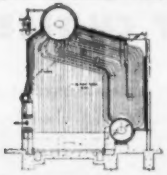
WICKES



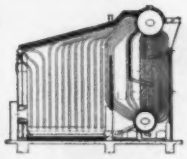
Crown "A" Type
Water Tube Boiler



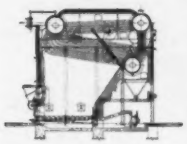
Type "T" Water Tube Boiler



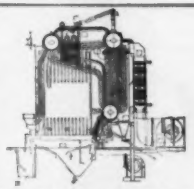
Type-S 2 Drum Boiler Series S1



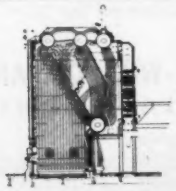
2 Drum Water Tube Boiler



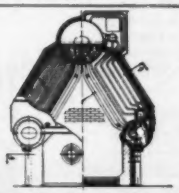
3 Drum Low Head
Water Tube Boiler



3 Drum "B" Type Water Tube Boiler



4 Drum Water Tube Boiler



N_3 Oil Fired Marine Service
Water Tube Boiler

Wickes Steam Generators are in constant daily service in thousands of installations throughout the world. Wickes can fill your exact requirements for boilers of any type up to 250,000 lbs. steam per hour and 850 psi. • Wickes Boilers are engineered for use in oil, chemical, paper and many other industrial uses as well as marine service. Our knowledge of steam generation is available for your consultation, without obligation. Descriptive literature available upon request.

• Remember — if you need steam you need a Wickes Steam Generator.

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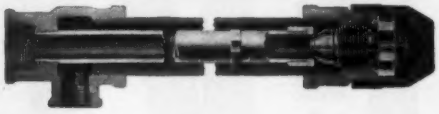
DIVISION OF THE WICKES CORPORATION
RECOGNIZED QUALITY SINCE 1854

131-A

ONLY 1 MOVING PART

in Nicholson Expansion Steam Traps



There is not a pin, not a bearing, not a link, nor a lever to wear in this Nicholson expansion steam trap. The valve is the only moving part. This extreme simplicity is resulting in remarkably low maintenance costs. There are hundreds of instances of traps in continuous service for as much as two years without even a sign of valve cutting.

Remarkably Low Maintenance Costs Shown on Many Varied Installations

Appreciable fuel savings are also being effected. Traps are easily adjusted to pass condensate at any temperature below 212°F, instead of at near steam temperature.

Easily installed, often without supports. Lengths, 18" to 40". Pressures, 0 to 250 lbs. No air binding.

FOR ALL EQUIPMENT
Using Steam or Hot Water

Radiators	Dry Kilns
Separators	Vulcanizers
Paper Machinery	Switch Heaters
Pipe Coils	Laundries
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W. H. NICHOLSON & CO., 125 Oregon St., Wilkes-Barre, Pa.

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about Breechings and Ducts

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For
TOP EFFICIENCY INSULATED PIPING SYSTEMS

Ric·wiL
is your BEST CHOICE

When you have an insulated piping problem, remember that only the best will give you ALL the advantages necessary to full-efficiency performance of your system. That means Ric-wiL Prefabricated Insulated Piping.

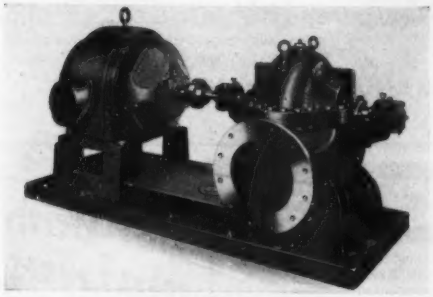
Ric-wiL provides (1) top-efficiency system engineering, (2) fast, economical installation, (3) the right protection and insulation for the job.

THE RIC-WIL COMPANY
CLEVELAND, OHIO

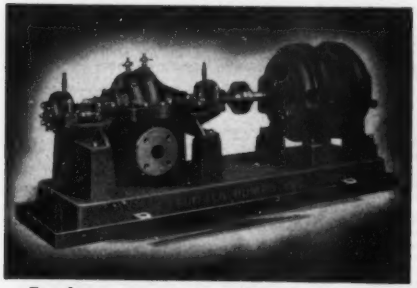
Ric·wiL PREFABRICATED INSULATED PIPING — UNDERGROUND OR OVERHEAD

The "LOW-BID" PUMP isn't necessarily the economical one!

"Buffalo" PUMPS SAVE MONEY ON THE JOB — WHERE SAVING COUNTS!



Above, for handling clear water, 10 to 10,000 gpm, you can't beat a "Buffalo" Type "SL" Pump.



For clear water, any temperature, at pressures up to 500 pounds, specify a "Buffalo" Type "RR" Pump.

If the pump has been built down to a price rather than up to a quality standard, chances are that any savings on first cost will be nullified by continual repair and replacement costs.

"Buffalo" Pumps have always been built to save your maintenance men trouble, to keep delivering for a maximum number of years and to use minimum power.

But why not get the construction and performance facts? Write today for Bulletins 955-N and 980-B, and see why "Buffalo" Pumps save money the minute they start on the job.

"Buffalo" PUMPS

BUFFALO PUMPS INC.

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Canada Pumps Ltd., Kitchener, Ont.
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A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

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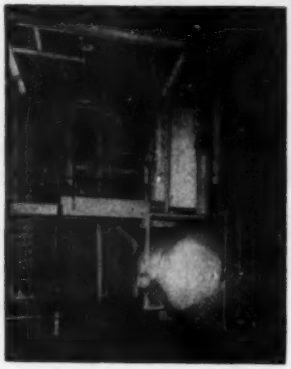
HOPPES FEEDWATER HEATERS



Deaerating feedwater heater serves as condensation return pump for trapped and pumped returns from heating system

ENGINEERING SERVICE:

Hoppes engineers work with you to assure that your individual and specific requirements are provided for in full. Let's talk it over—get the economy angle.

DEAERATING:

For medium and high pressure Central Stations; modern Industrial and Process Plants; Steam Heating Plants and all Modern Power Plants which have boilers operating at medium and high pressures.

NON-DEAERATING:

For Laundries; small Industrial Plants; Institutions and all smaller Power Plants where boilers are operated at lower pressures and where economy of investment is desired.

PLATE TYPE:

Deaerating heaters of plate type are designed for capacities up to 85,000 pounds per hour. Non-deaerating heaters include capacities up to 120,000 pounds per hour.

CAST IRON:

(Integral Unit) Designed to meet space limitations, their outlet capacities range from 3,000 pounds per hour to 15,000 pounds per hour.

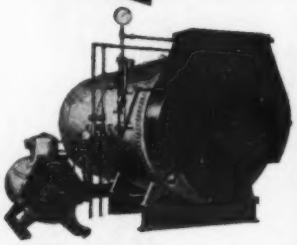
STEEL TYPES:

These heaters are more diversified and are obtainable as follows—Vertical or Horizontal heaters with integral storage; vertical heaters mounted on vertical storage tanks; vertical heaters mounted on horizontal storage tanks and horizontal heaters mounted on horizontal storage tanks.

HOPPES MANUFACTURING CO., Inc.

Established in 1881
SPRINGFIELD, OHIO

A BOILER With Economy
A LEFFEL Scotch Boiler!



Users of self-contained, compact Leffel boilers report fuel savings of from 20 to 40 percent over other types. The 17 sizes are available in ratings of from 6 to 250 *actual* horsepower. And the sturdy, dependable construction of all Leffel boilers permits substantial overloading with safety. Designed to burn COAL, GAS, or OIL, they are easily converted from one fuel to another. There is an efficient Leffel Scotch type boiler, *easy* to install, ready to go to work in your plant . . . today!

Write for descriptive catalog

The James Leffel & Co.

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Pumping Costs Go Down When Pump Quality Goes Up

Sier-Bath ROTARY PUMPS

The surest way to cut pumping costs is by specifying the best pumps you can find. Then—day after day—your power or process installation will run at top efficiency, with smallest chance of costly interruption, and lowest cost for pump maintenance and replacement.

★ **Point by point, Sier-Bath Rotary Pumps are designed and constructed to provide best operating characteristics, lowest maintenance, and greatest durability.**

GEAREX PUMPS
Internal and External Bearing Types. Capacities 1—550 GPM, Discharge 250 PSI for viscous liquids, 50 PSI for water.

SCREW PUMPS
Internal and External Bearing Types. Capacities 1—700 GPM, Discharge 1000 PSI for viscous liquids, 250 PSI for water.

★ **No Metallic Contact Between Rotors**—sustains high volumetric efficiency.

★ **Precision Cut Timing Gears**—maintain exact rotor clearance.

★ **High Volumetric Efficiency**—reduces wear caused by erosion.

★ **Low Pressure on Stuffing Boxes**—reduces leakage, adds to packing life.

★ **Long Life**—husky shafts, rotors—high load capacity bearings, deep stuffing boxes.

★ **Direct Connected Up to 1800 RPM.**

Available in corrosion resistant alloys, horizontal or vertical construction. Special bodies, stuffing boxes, bearings for high temperature applications.

WRITE FOR LITERATURE

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Sier-Bath GEAR and PUMP CO., Inc.

9254 HUDSON BLVD., NORTH BERGEN, N. J.

How to make a bit bite better

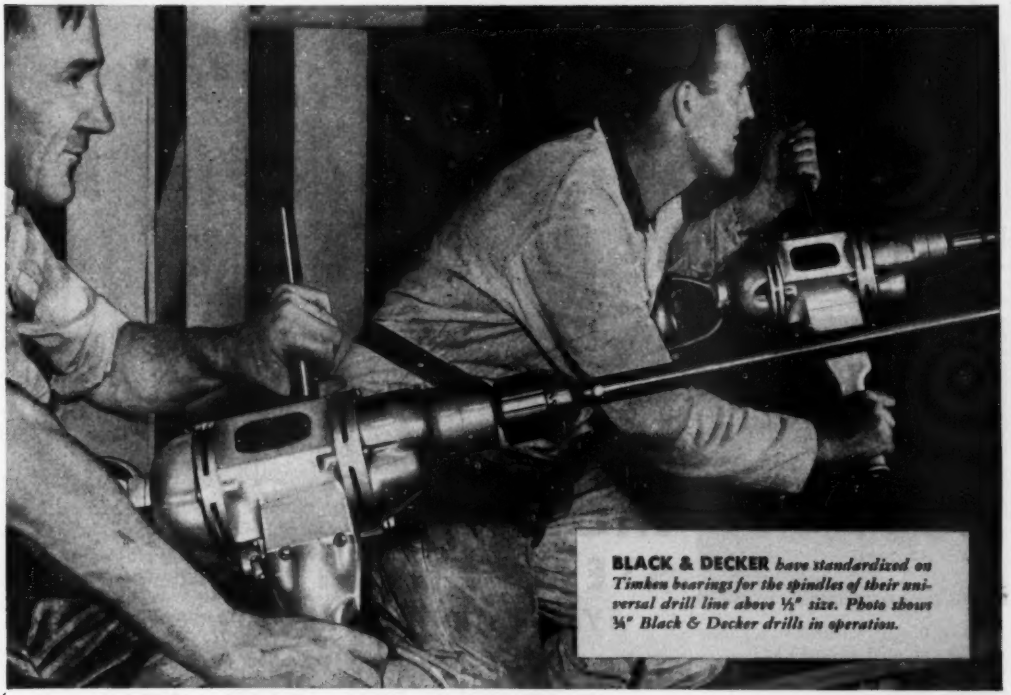
POWER drilling goes faster and easier when smooth power is transmitted to the drill. Black and Decker builds smooth power performance into the ¼" electric drills shown below by mounting chuck spindles on Timken tapered roller bearings.

Due to the line contact between rollers and races, Timken® bearings give spindles maximum support—free from vibration. And since Timken bearings carry both radial and thrust loads in any combination, end-play can be controlled to any desired limits.

Tools that are Timken bearing-equipped *keep* their precision. Friction in Timken bearings is virtually non-existent because of the true rolling motion of Timken bearings, plus their incredibly smooth surface finish. Bearing wear is kept to a minimum for Timken bearing rollers and races are made from Timken fine alloy steel—case hardened to give a hard, wear-resistant surface and a tough, shock-resistant inner core.

Insist that the tapered roller bearings you buy carry the trade-mark "Timken". And remember, Timken tapered roller bearings add an extra measure of value to the machine in which they are used. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ont. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



BLACK & DECKER *have standardized on Timken bearings for the spindles of their universal drill line above ½" size. Photo shows ¼" Black & Decker drills in operation.*

IT'S TIMKEN BEARINGS FOR VALUE!

To get the best value in bearings you may find this simple formula helpful:

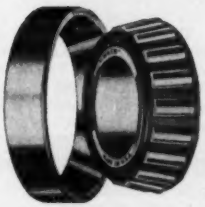
$$Value = \frac{quality + service + public\ acceptance}{price}$$

Obviously a big advantage *above* the line gives you more value than a small one *below*. No other bearing can match the uniform high quality, engineering and field service and overwhelming public acceptance you get with Timken bearings.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ◫ AND THRUST ↔◫↔ LOADS OR ANY COMBINATION ✳

High Pressure Steam
at Low Cost

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KEWANEE®

6 sizes for 6 to 36 hp at 100 lbs wp . . . For coal, oil or gas . . . hand or mechanically fired.

Check the proportions of each Scottie Jr. and you'll see why it will actually produce approximately double the horse power guaranteed by its rating.

WRITE Department 99-K5
for 6" scale with pipe diameter markings

KEWANEE BOILER CORPORATION
KEWANEE, ILLINOIS

Division of American Radiator & Standard Sanitary Corporation

LOCKED IN STRENGTH of Tri-Lok open steel flooring gives efficient load distribution, even on long spans. Get maximum strength, light, and air with minimum weight. Available in Rectangular, Diagonal, and Super-Safety U-type Flooring, and Stair Treads of all kinds.

The Tri-Lok Company is also equipped to furnish *riveted* and Tri-Forge *welded* open steel flooring. Tri-Lok grating can be furnished in a variety of metals, including aluminum alloy, stainless steel, etc. Write for Bulletin MW1140.

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HORSEPOWER RANGE

600# GA., 750° F.

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STEAM TURBINES
TYPE UV MULTISTAGE

The Type UV Multistage Turbine is available in from two to ten pressure stages making Multistage steam economy available at moderate initial cost. Horsepower range is from 100 to 4000, steam pressures up to 600# ga., 750° F., condensing or non-condensing. Several governors and accessories adapt UV Turbines to practically any mechanical drive within the capacity range.

Pictured is a 5 Stage UV Turbine developing 325 HP at 6200 RPM operating condensing. Turbine is equipped with variable speed oil relay governor, pressure lubrication and vacuum breaker, and is in use driving a centrifugal compressor for refrigeration.

Contact your Murray representative for prices and engineering information or write for Bulletin T-122.

MURRAY IRON WORKS COMPANY
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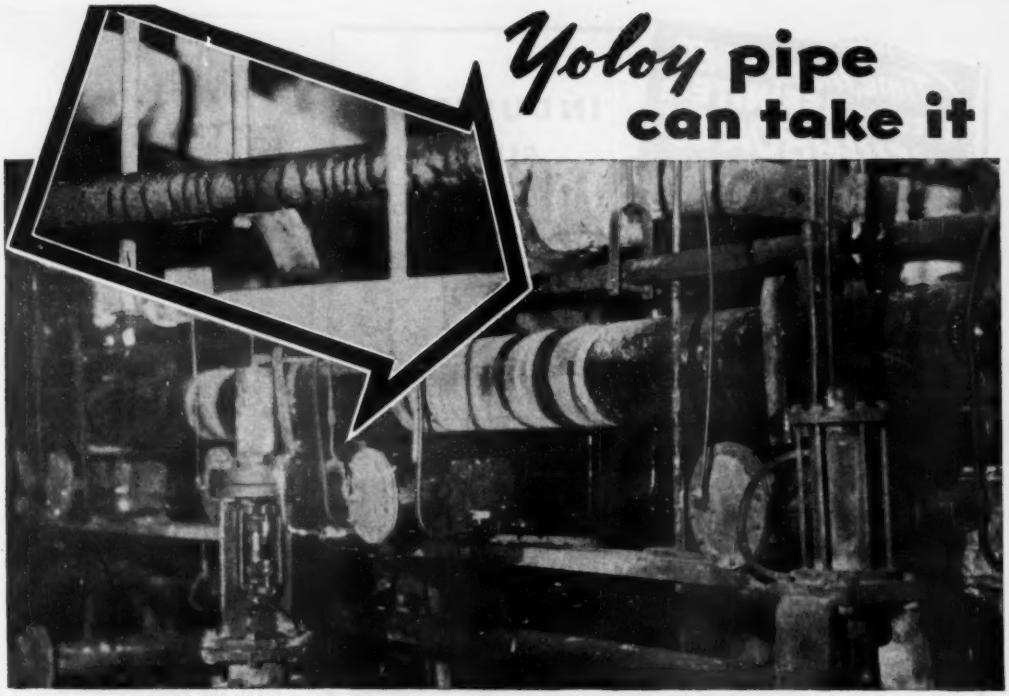
BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY

Yoloy pipe can take it



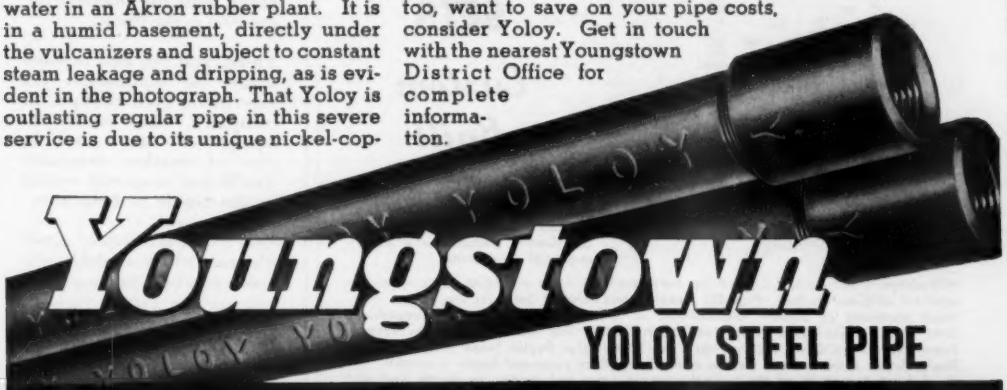
In the arrow inset above, you see a piece of 1½" Yoloy Continuous Weld Pipe. Subject to continual corrosion, it is still in use after nearly 4 years. Regular pipe used here previously had failed and been replaced at least once a year.

This Yoloy pipe is in a booster pressure line carrying 500 P.S.I. raw cold water in an Akron rubber plant. It is in a humid basement, directly under the vulcanizers and subject to constant steam leakage and dripping, as is evident in the photograph. That Yoloy is outlasting regular pipe in this severe service is due to its unique nickel-copper content or low-alloy composition.

In this installation Yoloy pipe has saved the manufacturer 50% of his pipe cost, 75% of his installation labor cost and has avoided three costly shutdowns for pipe repairs.

Yoloy standard weight black pipe is carried in stock for prompt delivery in sizes from ¾" to 3", inclusive. If you, too, want to save on your pipe costs, consider Yoloy. Get in touch with the nearest Youngstown District Office for complete information.

THE YOUNGSTOWN SHEET & TUBE CO. 1900 YOUNGSTOWN 1950 50 YEARS OF SERVICE



Youngstown

YOLOY STEEL PIPE

THE YOUNGSTOWN SHEET AND TUBE COMPANY — General Offices — Youngstown 1, Ohio

Manufacturers of Carbon, Alloy and Yoloy Steel — Export Office: 500 Fifth Avenue, New York

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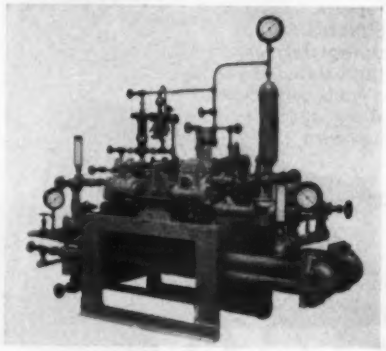
Custom Built



The efficient, compact unit illustrated consists of two Worthington Duplex Steam Pumps and two Griscom Russell Twin G-Fin Fuel Oil Heaters mounted on a single structural steel frame.

FOR almost a half century, Lockett has been supplying, to fit individual needs, efficient standard and custom-built, Fuel Oil Pumping and Heating Sets, for mechanical and steam atomizing oil burners. Combinations of various types of pumps are available: Either two Turbine-driven Pumps; one Electric-driven and one Turbine-driven Rotary Pump; two Electric-driven Rotary Pumps; two Worthington Duplex Steam Pumps; or one Duplex Steam Pump and one Electric-driven Pump. Each pump-and-heater is suitable for the full rated capacity of the unit; the second pump and heater are spares. Lockett supplies everything, complete. Inquiries are invited. *Descriptive bulletins sent on request.*

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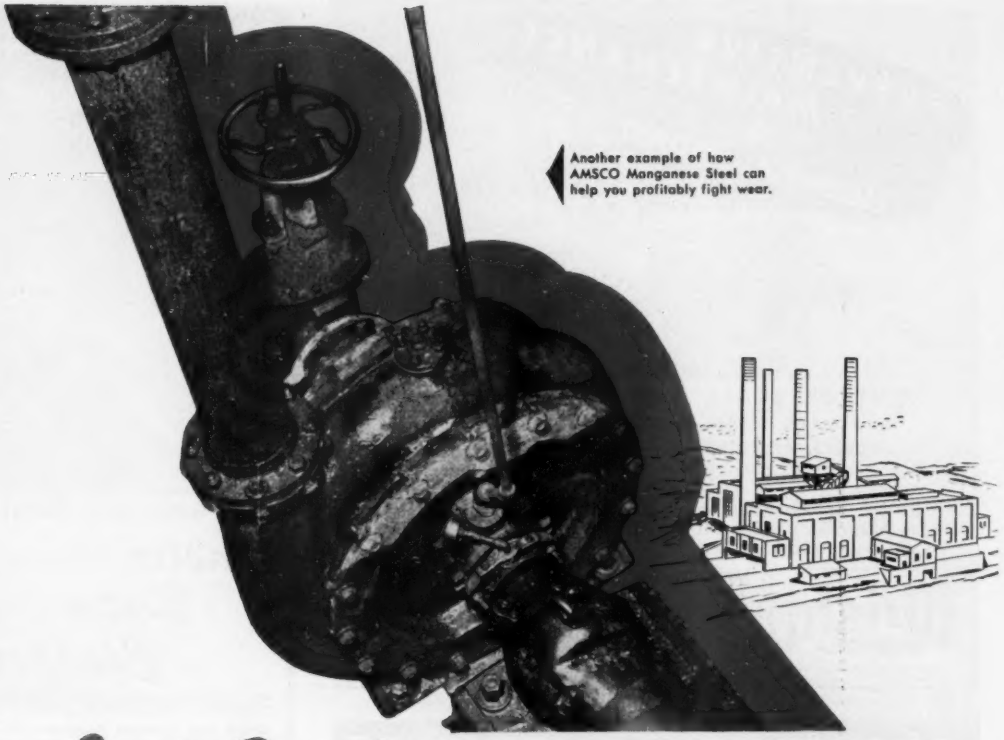

Another example of how AMSCO Manganese Steel can help you profitably fight wear.

Service Proved by 30 years of operation!

How an AMSCO Materials Handling Pump saved 65% on ash disposal costs

The Central Illinois Electric and Gas Co. at Rockford can speak with authority on the efficiency of AMSCO Materials Handling Pumps. They've been using these tough, wear-resistant pumps for 30 years! The photo above shows one of the first, if not *the* first pump of any make, used for ash disposal. This AMSCO Pump installation was put in service in June, 1921 and it's still in operation.

Naturally we're proud of its record. It cut ash disposal costs at this plant from $1.00 per ton way down to 35c per ton—*right from the start.* And, all through these 30 years, as replacements were necessary AMSCO Manganese Steel continued to be the most economical answer to the abrasive wear of ash.

These AMSCO Pumps are designed—and precision made—for a combination of efficiency and rugged service that means real economy. That's why so many hundreds of successful installations have been made since this first one in 1921.

WHEREVER YOU PUMP MATERIALS THAT CAUSE IMPACT AND/OR ABRASION . . .

. . . find out about longer-lasting, dollar-saving AMSCO Pumps. There's a size and type for every type of materials handling service . . . made by the world's largest producers of Manganese Steel castings for all industry.

AMSCO controls impact and abrasive wear in 5 basic industrial operations:

Power Transmission

Mining & Excavating

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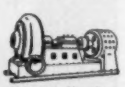

Materials Handling

Brake Shoe AMERICAN MANGANESE STEEL DIVISION

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Other Plants: New Castle, Del., Denver, Oakland, Cal., Los Angeles, St. Louis. In Canada: Joliette Steel Division, Joliette, Que.

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in BOILERS, STEAM and CONDENSATE LINES, WATER JACKETS, CONDENSERS — Wherever Water Is Used

Now, more than ever before, it is necessary to increase the efficiency and life of equipment by maintaining scale-and-corrosion-free water-side surfaces. Let experienced Wright Chemical Engineers check the requirements for water-conditioning chemicals to solve your problems.

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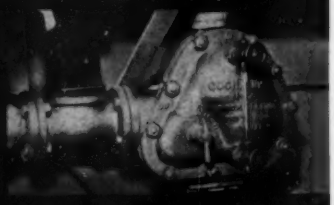
OFFICES IN PRINCIPAL CITIES
Sole Distributor of Nelson Chemical Proportioning Pumps

COCHRANE MULTIPORT DRAINER

(Continuous Flow Steam Trap)

CONTINUOUS DRAINAGE of low pressure condensate and HIGH DISCHARGE CAPACITY are features of the Cochrane Multiport Drainer that have made these continuous flow steam traps popular the world over.



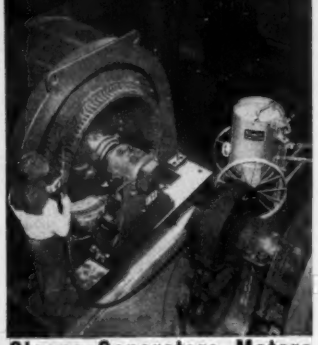
Balanced Rotary Valve and large port areas permit instant response to great discharge demands. Valve opening is determined by height of water in float chamber. As volume of water increases, the larger the valve opening becomes.

Other features: Valve never leaves its seat and is self-cleaning. Inlet at top prevents possibility of trap becoming air bound. Rotary Valve Seat is attached directly to float stem, one moving element. Write for Publication 4340.

COCHRANE CORP., 17th ST. & ALLEGHENY AVE., PHILADELPHIA 32, PA.

PANGBORN AC-4

"CORN COB" Blast Machine



Cleans Generators, Motors

Faster Better Cheaper

Eliminates Toxic Hazard of Solvents!

THE new portable Pangborn AC-4 Blast Machine scours armatures, parts, frames, coils, etc. in ⅓ the time of other methods. Material costs are reduced 90% and toxic or explosive solvents are eliminated.

Look at the savings shown by this recent test on electric motors. (Name of Company on request.)

Cleaning Duplicate 500 hp Synchronous Motors		
	Material	Labor
Solvent Method	$55.00	120 hrs.
PANGBORN Method	5.00	40 hrs.
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Remarks: With Solvent, drying period took an additional 8 hours.

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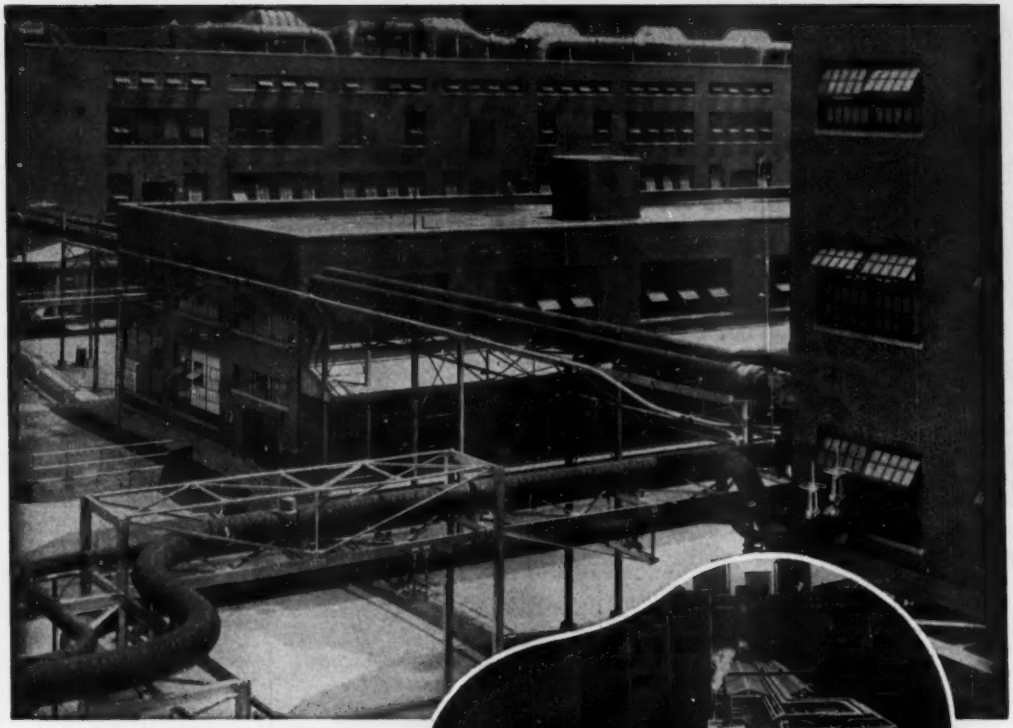
New Pangborn AC-4 Blast Machines use standard 40-pound air supply to remove oil and greases with blast of soft, 20-mesh corncob grits. No residue left on parts . . . no drying period.

FOR FULL INFORMATION, write today outlining your operation. Address: PANGBORN CORPORATION, 90 Pangborn Blvd., Hagerstown, Maryland.

Look to Pangborn for the Latest Developments in Blast Cleaning and Dust Control Equipment

Pangborn

BLAST CLEANS CHEAPER with the right equipment for every job



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Careful and expert preliminary engineering work by Navco Engineers, in addition to employing the most modern fabricating and erection methods, are your guarantee of operating savings.

Consult Navco for just a Pipe Bend, or a complete Piping System.

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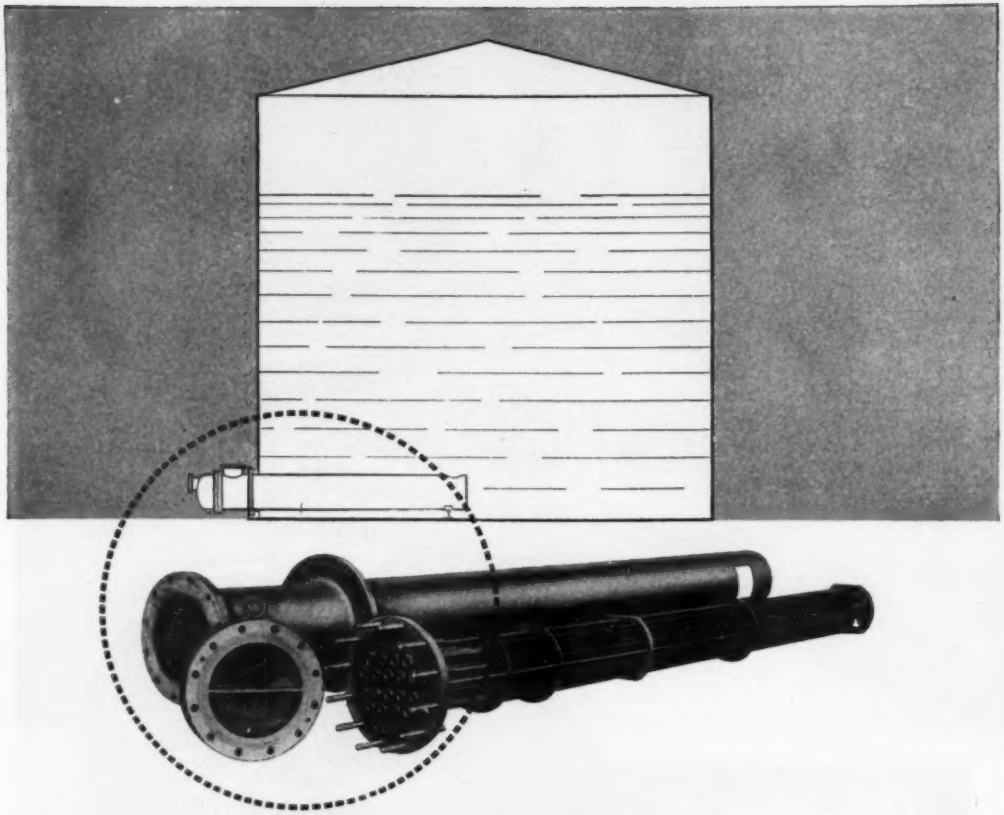

Why G-FIN...
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Here is the most practical unit for heating oil to be withdrawn from storage tanks.

The effectiveness, compactness, dependability and ease of inspection and maintenance of the G-Fin Storage Tank Oil Heater have made it widely used for every type and grade of viscous oil.

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GR-381 A

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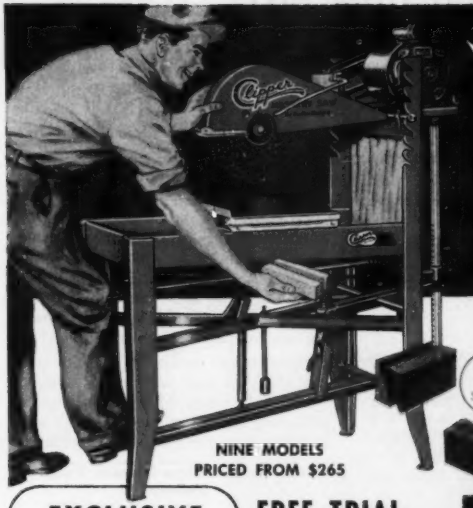

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Any **SPECIAL SHAPES** *SKEWS, SPLITS, ANGLES, SOAPS*

CUT IN SECONDS with a *DUSTLESS* CLIPPER MASONRY SAW

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PERFECTLY SMOOTH CUTS ELIMINATE HIDDEN FRACTURES, EXCESS MORTAR ... and "DOWN-TIME"

Speed REPAIR or CONSTRUCTION of your Furnaces by using a CLIPPER MASONRY SAW.

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AUTOMATIC BLADE PRESSURE
Makes your blades last longer . . . Because Equalizer Spring Automatically cushions blade pressure whether cutting HARD or SOFT materials. Outstanding for blade economy.

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One man easily adjusts Cutting Head to desired height... Whether cutting 12" or 1" material. Operator's hands merely guide. Weight supported by rear Bar.

SAVE-A-BLADE DIAL
Just turn the Save-A-Blade Dial to the material hardness and the pressure Equalizer Spring automatically sets the tension—guarantees faster cutting and longer blade life.

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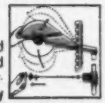
Pull the knob—and the Cutting Head is free for finger tip setting at any desired angle. Release the Knob—and Head is locked in the desired position.



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The outstanding policy of *FREE TRIAL* has been in effect since Clipper invented the world's first Masonry Saw. Only through this Clipper *"FREE TRIAL"* are you guaranteed... ACTUAL TEST ON THE JOB...FULL SATISFACTION ...NO OBLIGATION!

DUSTLESS *Masonry Cutting*

With the MODEL HD CLIPPER you can choose your cutting method... cut DUSTLESS (wet) in confined areas or DRY when DUST is not a problem. Remember too, there are NINE Clipper Models designed to perform with smooth simplicity and flexibility.

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You Save Time and Material when you cut straight, smooth edges . . . then Break Out

5 Models.. Gas or Electric Powered

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CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

"Bridgeport" MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND. — IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

Keeping Equipment In Efficient Operation

At the annual conference and exhibition of the National Association of Corrosion Engineers held at Hotel Statler, New York, March 13-16, we asked many of the visitors at our booth what problems were uppermost in their minds. Keeping equipment in efficient operation with the minimum of shutdowns is the objective of operators. Corrosion is the greatest menace to the life of equipment. Not only is the selection of the corrosion-resisting materials of paramount importance but careful control and understanding of operating conditions are most essential.

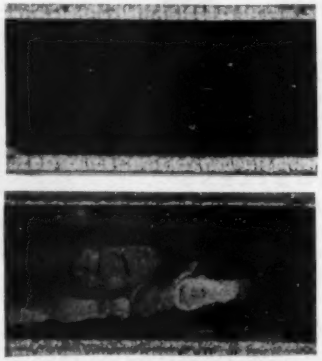
Unfortunately, there are many uncontrollable factors resulting from changes in operating conditions which affect the corrosive character of solutions and make maintenance troublesome. Changing conditions naturally affect the corrosion rate.

The need for greatly increased production often taxes the available equipment since the output is much greater than the equipment is designed to handle. The corrosion rate from the product side is greatly speeded up and the life of the equipment is proportionately reduced.

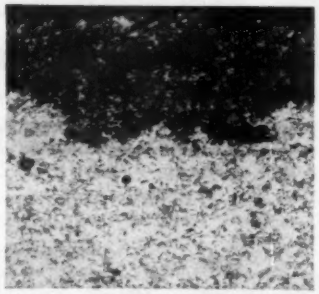
The handling of larger quantities of products generally requires greater cooling or heating capacities which are obtained by increasing the water or steam velocities. In some cases the higher velocities may tend to keep the tubes cleaner and are, therefore, beneficial. Again, exceptionally high water velocities may tend to accelerate impingement corrosion and shorten the service life of the tubes. When the impingement attack is at the inlet ends of the tubes, the use of inserts to take the brunt of the attack is recommended. Inserts are replaceable when the useful life of the old ones is destroyed.

Dezincification Can Be Reduced

Sometimes an alloy is used which is not suitable for existing conditions. Dezincification has occurred in tubes, and other parts of equipment made from uninhibited high-zinc-content brasses, especially when in contact with non-scaling types of waters. By using inhibited alloys, as for example, arsenical admiralty, arsenical aluminum brass, dezincification can be reduced or entirely eliminated. Arsenical copper and



Bottom half, longitudinal section of yellow brass pipe showing nodules of corrosion products covering areas of plug-type dezincification developed on the floor of the pipe. Note absence of nodules in top half of pipe.



"Layer-type dezincification" is recognized by relatively thick layers of deposited copper built up over a period of time. Micrograph mag. 75X.

red brass (85% copper, 15% zinc) will give much longer life in most waters than uninhibited yellow brass or uninhibited admiralty.

Trouble is experienced from paper mill liquors during the recovery cycle, primarily because of the presence of sulphides and other sulphur compounds. The steam coming from the evaporators containing much H_2S gas is well resisted by Muntz metal. 70-30 cupro nickel has given satisfactory service for handling "white liquor."

River water contaminated with sulphide wastes may also attack copper tubes. Admiralty, Muntz, and aluminum brass inhibited with arsenic are superior to copper for this condition.

Vibration Often Causes Tube Failure

Some operators are having trouble from excessive vibration of the tubing in condensers and heat exchangers. This occurs more often in re-tubed equipment where the holes in the support plates may have been enlarged, permitting a loose fit. Or the position of the support plates may have been moved, thus changing the vibration characteristics of the tubes. Periodic vibration is set in motion through the pulsating action of pumps, compressors, motors, or other equipment in proximity to the tubes. Sometimes it is helpful to change the speed of the pumps or motors to stop the tubes from vibrating excessively. Additional support plates or relocation of the support plates sometimes help.

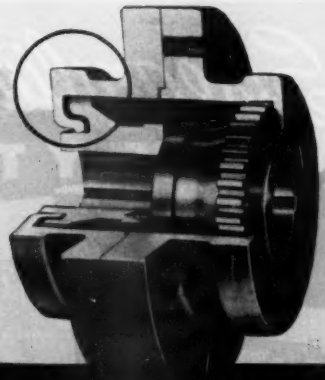
Duplex Tubing Solves Double Corrosion Problems

To overcome the corrosive effects from gaseous hydrochloric acid either dry, wet, or mixed with other gases, Duplex Tubing with nickel to the hydrochloric acid side and a copper-base alloy to the water side is recommended. For sulphuric acid solutions, Duplex tube with lead to the acid side and copper to the steam or water side is superior to most other metals for this type of corrosion.

Steam erosion resulting from the impingement of wet, corrosive steam on condenser tubes sometimes gives trouble. Grids or deflector plates in the path of the steam will help protect the tubes. Sometimes a change in alloys is necessary. Where the corrosive agent is a trace of ammonia, 70-30 cupro nickel is superior to copper or the brasses. Where CO_2 in the steam is the corrosive agent, Duplex tubes with stainless steel outside and a copper-base alloy inside are called for. (6645)

(Advertisement)

NEED "SPECIAL" COUPLINGS?



Koppers Can Help You Save Money With *Easily Modified*

STANDARD Fast's Couplings

FOOLPROOF DESIGN: Instead of perishable oil seals, Fast's use a permanent metal-to-metal closure. Oil is always maintained at a safe level, whether the Fast's is running or standing still!

LOWEST COST: Fast's Couplings cost less per year because they normally outlast the equipment they connect. Original cost can be divided by 20 years or more. As one user says: *"We've had this Fast's Coupling since 1930 . . . it's apparently going to last forever!"* (Name on request.)

NEW DEVELOPMENTS: Fast's were the first gear-type couplings on the market. And they're first again with new designs developed by Koppers—like the revolutionary new Breaking Pin Coupling now available.

IF YOUR coupling problem looks tough—specify Fast's. Then Koppers' engineers can go to work, study your problem, and in many cases find a special coupling is not needed at all. Instead, these coupling specialists can often modify a *standard* Fast's Coupling and save you important money!

Standard Fast's Couplings can be modified for hundreds of unusual applications. Records kept over the past 31 years prove that Fast's Couplings outlast the equipment they connect. Fast's still maintains its original design, without basic change or sacrifice in size or materials.

Don't take chances. Whether your application calls for special or standard couplings, specify Fast's. For full information and specifications, write for your copy of Fast's free catalog today!

KOPPERS

FAST'S

THE ORIGINAL GEAR-TYPE

Couplings

INDUSTRY'S STANDARD FOR 31 YEARS

Mail **COUPON TODAY FOR FREE CATALOG!**

KOPPERS CO., INC., *Fast's Coupling Dept.,*
225 Scott St., Baltimore 3, Md.

Gentlemen: Send me Fast's Catalog which gives detailed descriptions, engineering drawings, capacity tables and photographs.

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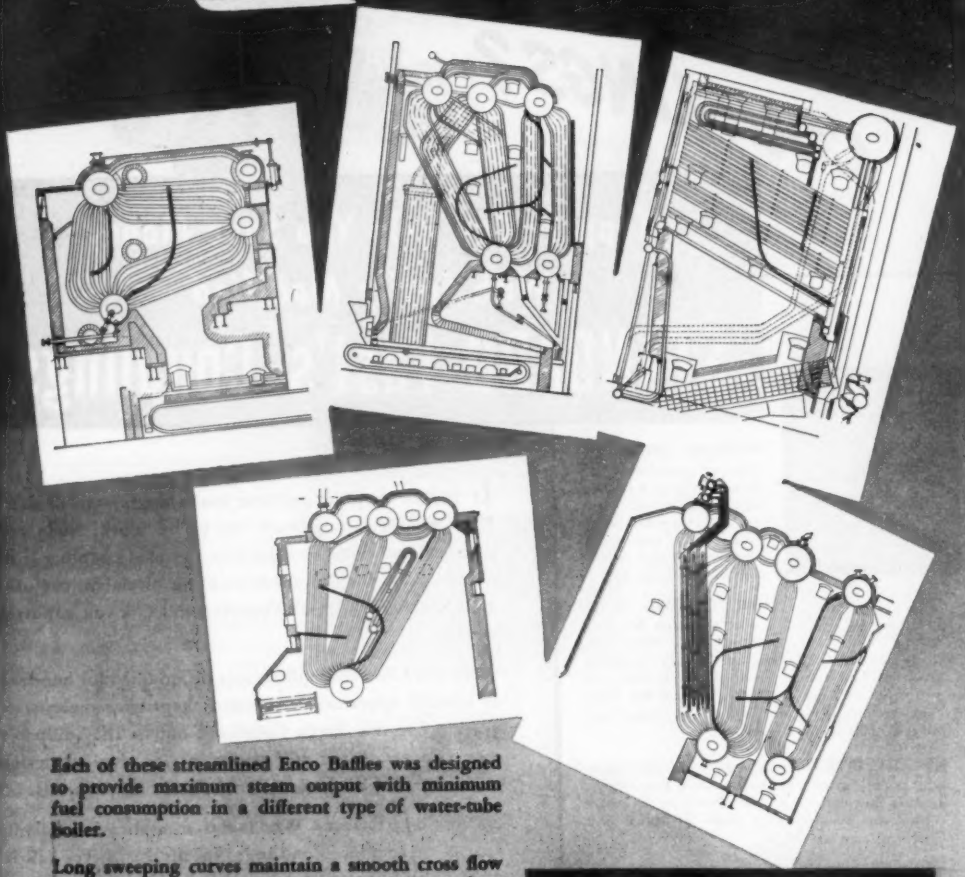
Company.....

Address.....

City.....Zone.....State.....

Streamlined for Savings

IN EVERY TYPE OF BOILER



Each of these streamlined Enco Baffles was designed to provide maximum steam output with minimum fuel consumption in a different type of water-tube boiler.

Long sweeping curves maintain a smooth cross flow of gases across every square foot of heating surface. Eddy currents, bottlenecks and dead gas pockets are eliminated—draft losses are cut to a minimum. Soot blowers work more effectively, less steam and less time are needed for cleaning.

Enco Streamline Baffles are individually designed and engineered to the exact requirements of your boiler. Experienced Enco-trained crews take charge of the installation.

The 18-page Enco Bulletin, BW44, shows how engineers throughout industry have gotten higher boiler efficiency and increased steam production through the use of Enco Streamline Baffles. Why not write for your FREE copy today?

The Engineer Company Produces:

ENCO OIL BURNERS

ENCO FUEL OIL PUMPING AND HEATING UNITS

ENCO AUTOMATIC OIL-ELECTRIC IGNITION SYSTEM

ENCO AUTOMATIC COMBUSTION CONTROL

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75 WEST STREET, NEW YORK 6, N. Y.

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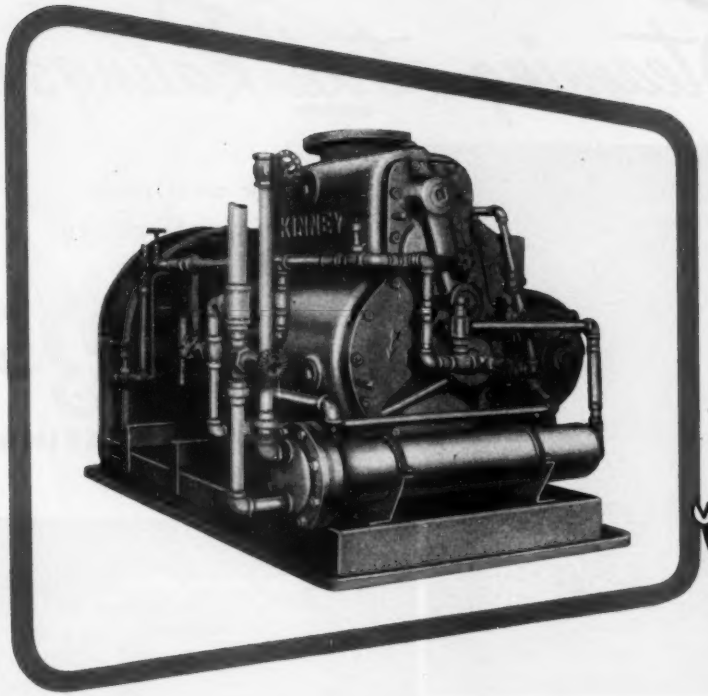
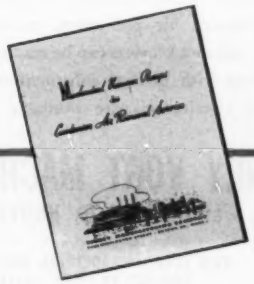


LOOMS UP BIG IN THE POWER PLANT PICTURE!

In the planning of high-pressure, high-temperature power plants, Kinney Mechanical Vacuum Pumps belong in the picture. Check the advantages of these pumps for condenser air removal — advantages already well-proven by actual installations in many of the country's leading steam generating stations:

- **Push-button control.** Like other motor-driven auxiliaries, Kinney Pumps can be operated from the central control room.
- **Low maintenance, no nuisance.** Kinney Vacuum Pumps set a new high for day-after-day dependability.
- **Low cost of installation.** These pumps eliminate the high pressure piping, fittings, and troublesome reducing valves required by hogging jets.
- **Removal of contaminants.** Once ammonia, carbon dioxide, and other corrosive gases pass through the Kinney Pumps, they're gone for good. There's no danger of concentrating these contaminants as with steam-jet ejectors.

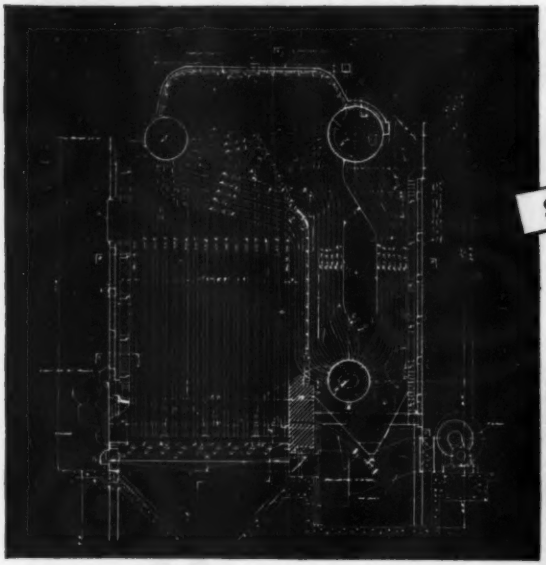
Plan now for these profit-producing advantages. Kinney Engineers will gladly show you facts and figures on Kinney Pumps. KINNEY MANUFACTURING CO., 3532 Washington St., Boston 30, Mass. Representatives in New York, Chicago, Cleveland, Houston, New Orleans, Philadelphia, Los Angeles, San Francisco, Seattle and in foreign countries.



Send for this comprehensive report: "Mechanical Vacuum Pumps in Condenser Air Removal Service".

Kinney VACUUM PUMPS

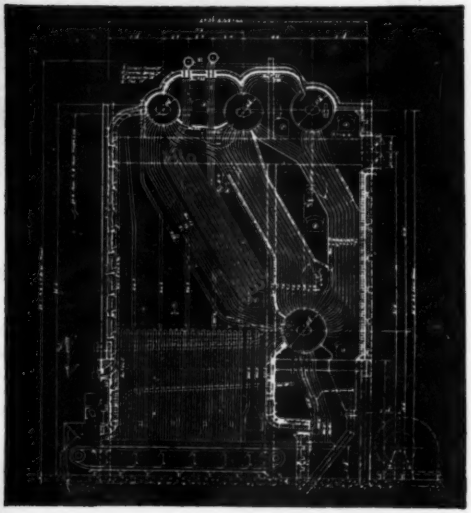
Quick Steaming at all Ratings!



Carry high overloads with high efficiency

SPECIFY Vogt

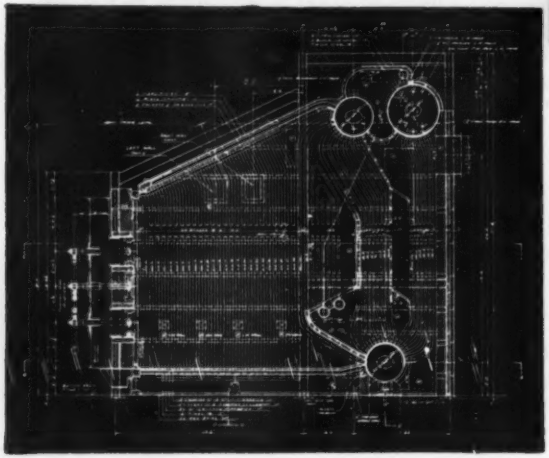
STEAM GENERATING UNITS



CLASS VL Two 27,500 pounds per hour units, installed at Brown-Forman Distillers Corporation, Louisville, Ky. Features large furnace volume in limited space, with high ratio of radiant heating surface.

CLASS LE Mt. Carmel Public Utility, Mt. Carmel, Illinois, is served by this 60,000 pounds per hour unit. Generous steam liberating surfaces and steam space permit wide fluctuations in load.

CLASS VR 70,000 pounds per hour steam generator at Humble Oil and Refining Company, Johnsue, Texas. An efficient, high-duty unit with water cooled furnace, using refinery gas fuel.



Vogt builds a complete line of bent tube steam generators, designed to burn solid, liquid, or gaseous fuels to meet specific operating conditions. Superheaters, air preheaters, economizers, water walls, and soot blowers can be readily incorporated. Bulletins with general information and showing typical installations are available upon request.

HENRY VOGT MACHINE CO.
LOUISVILLE 10, KENTUCKY

BRANCH OFFICES:
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For worms and gears—in standard sets or to special requirements—or as worm-gear speed reducers, including the economical fan-cooled Speedaire unit—you can always depend on Cleveland.

High quality worms and gears to meet your needs

● You pay no more for Cleveland worms and gears—and yet, built into them are extra years of service and satisfaction.

Uniform, high quality has been an outstanding characteristic of Clevelands through 38 years—a generation devoted to the manufacture of fine worms and gears exclusively. Specifically, there are four ingredients of Cleveland quality:

1. Correctness of design—design proved best by years of performance.
2. The finest of materials, selected after years of experience and research.
3. Modern machine tool equipment, in a modern plant kept up-to-date by a policy of continuous replacement.
4. Machinists and other production workers who are craftsmen, trained in precision work.

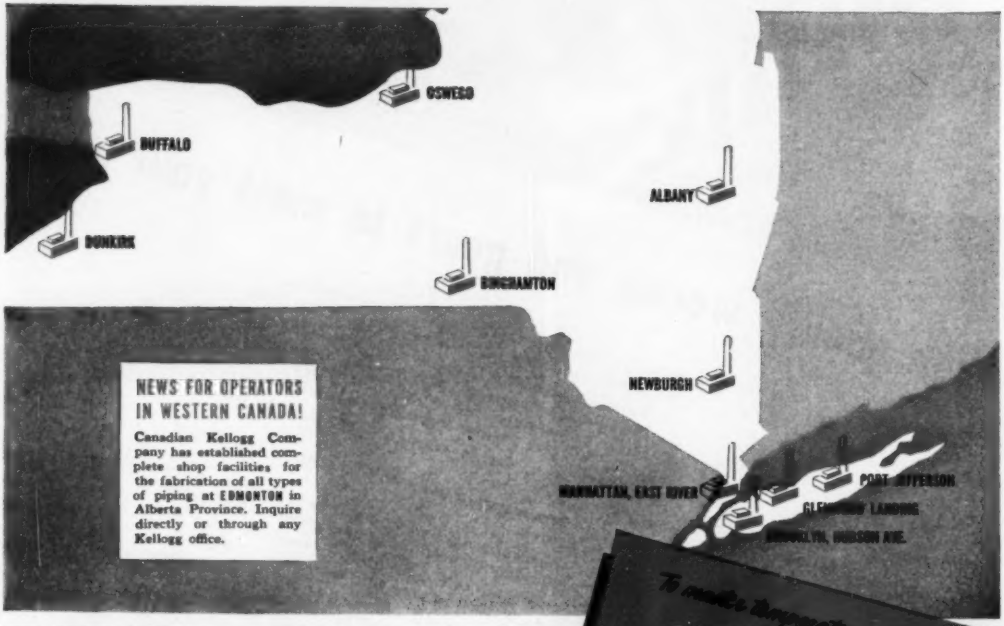
So whatever your need, consult Cleveland. Sales representatives in all major industrial centers are at your service, to help you select correct types and sizes and discuss any phase of your power transmission problems.

Write for the latest Cleveland catalog, indicating your requirements. The Cleveland Worm & Gear Company, 3262 East 80th Street, Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers Limited.

Note: Over 1,250,000 kws for New York State alone!

...within a very short space of time, we have contracted to fabricate the major power piping for over 1,250,000 kws. of additional steam power capacity for New York State alone. Most of these orders include job-site installations as well. All piping is for modern high-pressure, high-temperature systems — predominantly of the reheat type — with operating temperatures of 1000°F. or higher. When completed these new power installations will expand the state's total steam-generated capacity by well over 20%.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Special studies of unusual problems such as graphitization to assure long life and low maintenance.

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Exclusive Equipment for accurately analyzing stresses in piping and providing unique data for critical installations.

Complete facilities for the fabrication of steel products from simple forgings to specially cast bi-metallic devices.

Top welding performance in shops and in the field by welders accustomed to working under X-Ray checks.

Quality control, devised by metallurgical experts, embracing forming, heat treating and non-destructive testing.

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Giant One-Piece Bends
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Radial Brick Chimneys

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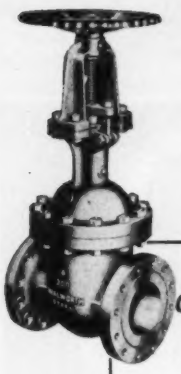
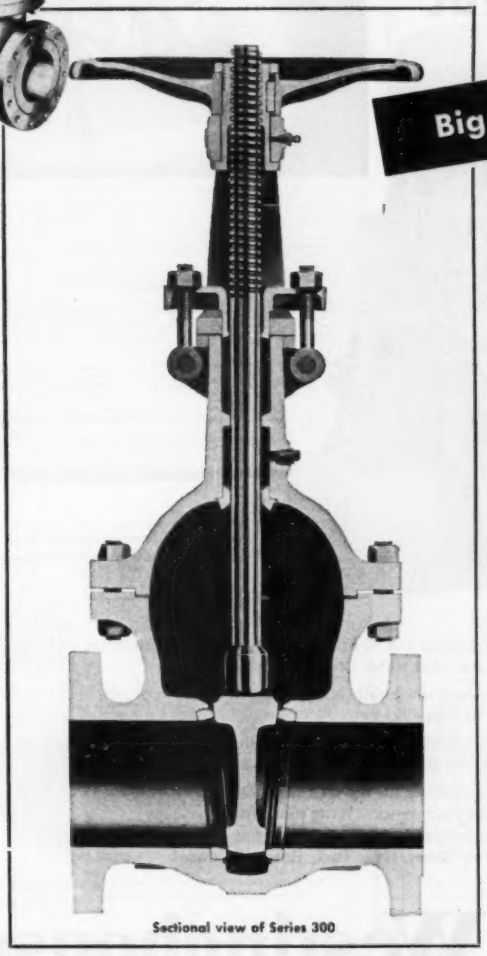
WALWORTH

Cast Steel Gate Valves

Series 150 and 300

Wedge Gate — Outside Screw and Yoke





Sectional view of Series 300

Big 8-Point Superiority!

Gland clearances are such that stem cannot be scored if gland should be tightened unevenly.

Deep Stuffing Boxes in all sizes (2" to 24") insure tightness and maximum packing life — costly leaks are eliminated.

Bonnets and Bodies are engineered to withstand pressure and minimize distortion — they're tough, durable, dependable.

Heavy Steel Walls provide extra strength and longer life.

Integral Body Guide Rib Faces are machined to insure accurate disc seating.

Seat Rings are bottom seated — not flange type. No recess exists at back of ring — hence no turbulence, erosion, or pressure drop.

Streamlined Ports allow high velocity, non-turbulent flow, and reduce the possibility of erosion.

Valves regularly have flanged ends. They can be supplied with ends for butt welding. Roller bearing yokes are available. On valves 5 inches and larger, by-passes can be furnished.

For Series 600 and higher, we recommend Walworth Pressure-Seal Steel Gate Valves.

For further information on Walworth Cast Steel Gate Valves, see your local Walworth distributor, or write:

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A NEW CATALOG...

ON POWER-SAVING

VANE CONTROL®

Cutaway of a Sturtevant Induced Draft Fan shows VANE CONTROL and the E-R (Erosion Resisting) Wheel.

Just off the press, Descriptive Bulletin DB 92-810 gives you complete information and data on the *new* Sturtevant Adjustable Inlet VANE CONTROL.

This power-saving control has been universally accepted as the economical way to obtain variable fan output at high efficiency.

VANE CONTROL's new, easily operable link and lever system is completely outside the gas stream on Induced Draft fans. No abrasive dust ever reaches the operating mechanism.

Sturtevant VANE CONTROL is available for use on Forced Draft fans, Induced Draft fans, Industrial fans, and Centrifugal Compressors. Write today for a free copy of DB 92-810. Address Westinghouse Electric Corporation, Sturtevant Division, 144 Damon Street, Hyde Park, Boston 36, Mass.

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J-80218

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Investing in a Heyl & Patterson

KINNEY CAR UNLOADER

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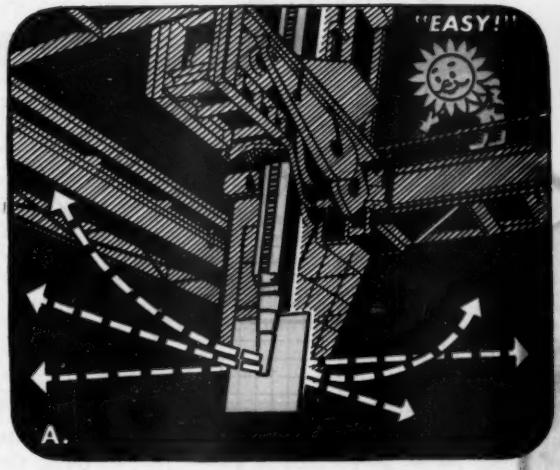
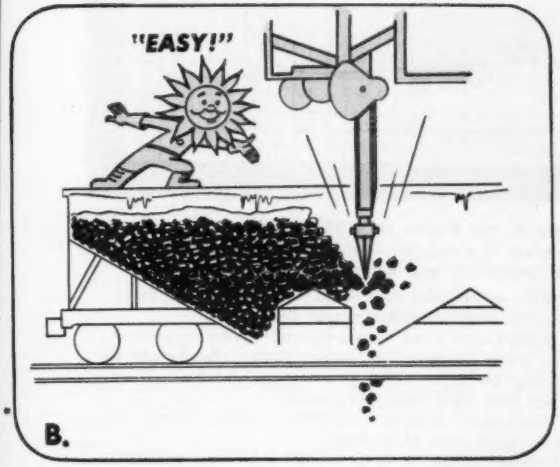
PROTECTS YOUR PRODUCTION IN SEVERE WINTER WEATHER

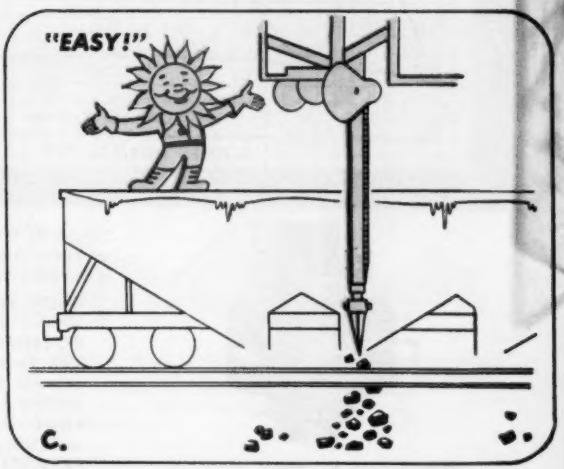
"EASY" Does It. (A) The H&P Kinney Car Unloader consists of a movable bridge equipped with a trolley which carries the Unloading Spade and its operating mechanism. The bridge may run on a Crane Runway or may be designed as a Gantry.

"EASY" Does It. (B) In breaking up frozen coal and forcing it through the hopper opening the frozen chunks are reduced in size to where they will not clog the track hopper or feeders and can be handled on a conveyor belt.

"EASY" Does It. (C) The H&P Kinney Car Unloader enables one man to unload a 70-Ton Car of Frozen Coal in 20 minutes or less. It can also be used as a Car Mover.







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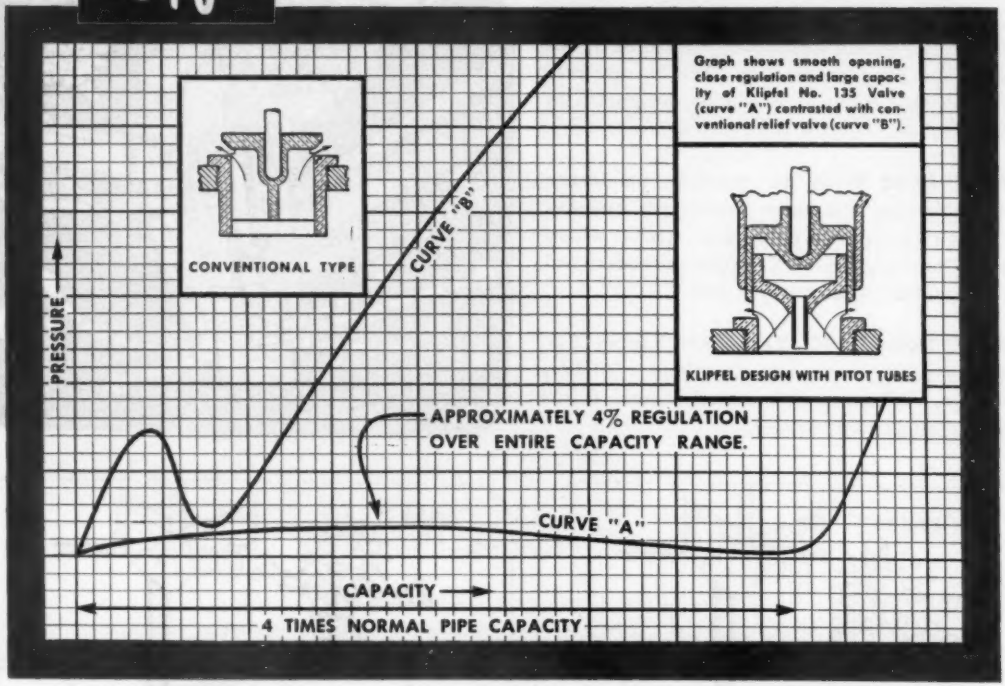
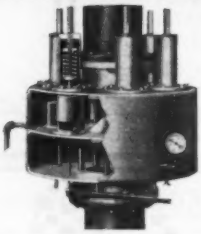
Using relief valves?

CHECK THE PERFORMANCE

OF Klipfel NO. 135 SINGLE and MULTIPORT VALVES


Graph shows smooth opening, close regulation and large capacity of Klipfel No. 135 Valve (curve "A") contrasted with conventional relief valve (curve "B").
CONVENTIONAL TYPE
CURVE "B"
KLIPFEL DESIGN WITH PITOT TUBES
PRESSURE
APPROXIMATELY 4% REGULATION OVER ENTIRE CAPACITY RANGE.
CURVE "A"
CAPACITY
4 TIMES NORMAL PIPE CAPACITY



PERFORMANCE CHARACTERISTICS

Compensated Spring Loading—*by using fluid velocity.*

Tight Closing—*with thin edged seat for low venturi effect.*

Chatter-proof Operation—*though inherent dash-pot construction.*

Multiport Valves—*open in sequence minimizing wire drawing and improving regulation. Positive testing of each valve with external handle.*

Single or multiport, the Klipfel No. 135 maintains steam back pressure accurately. Among the features which have made it a favorite with operating and maintenance men are:

INNER VALVE—*an inverted cup slides smoothly on a piston which is integral with the threaded seat bushing.*

EXTERNAL SLEEVE—*an extra feature—permits close regulation with variable outlet pressure by venting spring chamber to a constant pressure source.*

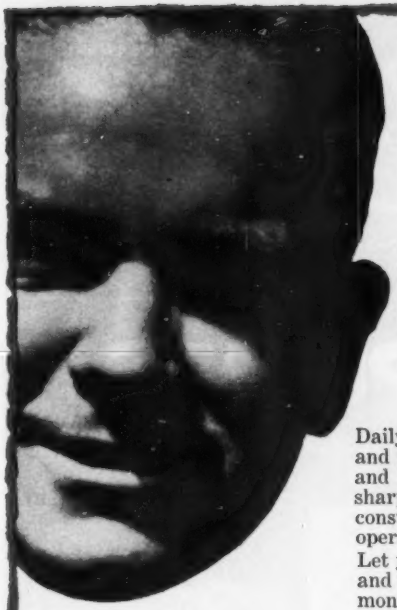
SPRING—*extra long with low spring scale.*

BODY—*in single port, bronze, semi-steel or steel casting. In multiport, all-welded steel plate body.*

PRESSURE RANGE—*single port, up to 300 P.S.I.G.; multiport, vacuum to 20 P.S.I.G.*

FOR FULL DATA on the Klipfel No. 135, write Dept. BC-5

Klipfel VALVES INC.
DIVISION OF
HAMILTON-THOMAS CORP.
HAMILTON, OHIO



whether you manufacture

buttons or bulldozers . . .

here's a good man to know!

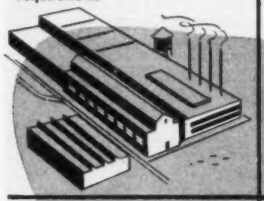
your Carey Industrial Sales Engineer

Trained to solve your building construction and maintenance problems . . . boost efficiency of your processing and manufacturing operations

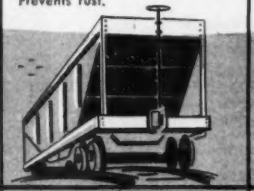
Daily experience with diversified problems in construction and maintenance of buildings . . . as well as manufacturing and process operations . . . keeps this man's skills razor sharp. Use these skills to cut the fat from *your* building construction and maintenance costs . . . to whittle down operating expense!

Let your Carey Industrial Sales Engineer tell you how these and many other Carey industrial products can help you save money, cut costs!

Built-up Roofing—for every industrial and commercial roofing requirement.

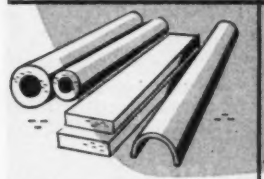


Car Cement for coating interior and exterior metal surfaces and joints. Seals out dirt, moisture. Prevents rust.

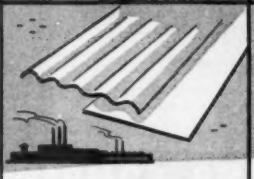


Asbesto-Sorb — thirsty fibers of asbestos that soak up oil, water, chemicals, to help maintain safety underfoot.

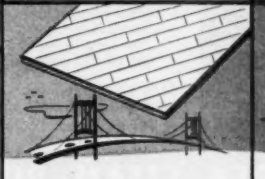
Pipe Line Felt — prevents corrosion and breakdown of vital underground liquid and gas pipe line installations.



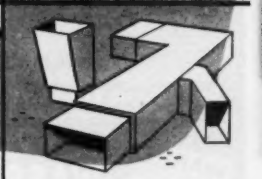
Super-Light 85% Magnesia Insulation—To prevent loss of heat energy in power plants, processing, manufacturing and plant heating operations.



Careystone Asbestos-Cement—a versatile roofing and siding material available in flat or corrugated form; resists fire, weather, corrosive chemicals.



Asphalt Plank—tough, boardlike, with a mineral surface that defies wear, prevents skids. Widely used for bridge and industrial flooring applications.



Careyduct—non-corrosive asbestos-cement duct to keep buildings breathing easy.

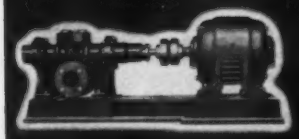
From the House of Carey—
Serving Industry Since 1873

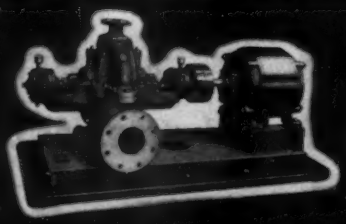
Write for the name and address of the Carey Industrial Sales Engineer in your locality!

Carey.

The Philip Carey Mfg. Company, Lockland, Cincinnati 15, Ohio
In Canada: The Philip Carey Co., Ltd., Montreal 25, P.Q

Warren-Quimby
Gear-in head Screw Pump



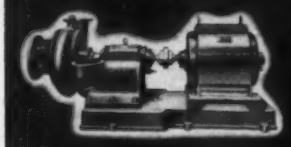


Warren Condensate Pump

Warren Horizontal Duplex
Hydraulic Pump

WARREN PUMPS

Maintain efficiency • Operate at low cost • Are long-lived



Warren Type "L" Single-Stage
Single-Suction Liquor Pump

CENTRIFUGAL

Single and Multi-stage
Pressure range: Up to 1200 P. S. I.
Capacities: Up to 50,000 G. P. M.
Types: Horizontal and Vertical
Impellers: Open or Enclosed

RECIPROCATING

Horizontal and Vertical Single Piston
Horizontal and Vertical Duplex Piston
Single and Duplex Outside Packed Plunger
Single, Duplex and Compound Hydraulic
Steam Heat Vacuum
Automatic Pump and Receiver, etc., etc.,

WARREN-QUIMBY SCREW PUMPS

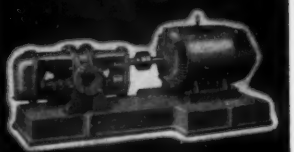
Gear-in-head and External Gear and Bearing
Capacities: Up to 3000 G. P. M.
Pressures: Up to 200 P. S. I. on low viscosity liquids; practically unlimited on high viscosity liquids
Horizontal or Vertical Mounting

WARREN-QUIMBY ROTARY PUMPS

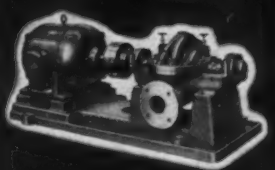
Gear-in-head and External Gear and Bearing
Capacities: Up to 1000 G. P. M.
Pressures: Up to 250 P. S. I.
Horizontal or Vertical Mounted

Send your pumping problem to us; Warren Engineers will recommend the right pump for the job.

P-28



Warren-Quimby External Gear
and Bearing Rotex Pump



Warren Type DBL, Single-Stage
Double Suction, Centrifugal Pump

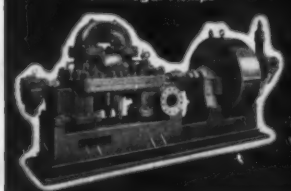
Warren Two-Stage Volute
Centrifugal Pump

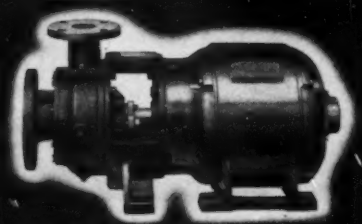
WARREN QUIMBY PUMPS

WARREN STEAM PUMP COMPANY, INC.

WARREN, MASSACHUSETTS

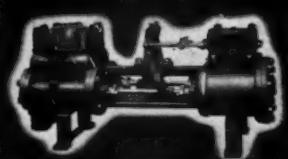
Warren 4- and 6-Stage
Centrifugal Pumps





Warren "Compacunit"—4 Types—42 Sizes

Warren Horizontal "Realwear"
Duplex Piston Pump



MORE POWER FOR DEFENSE

MECHANIZE Your Boiler Water Conditioning!

- IMPROVE HEAT TRANSMISSION
- SAVE FUEL
- REDUCE COSTLY SHUTDOWNS FOR REPAIRS AND CLEANING

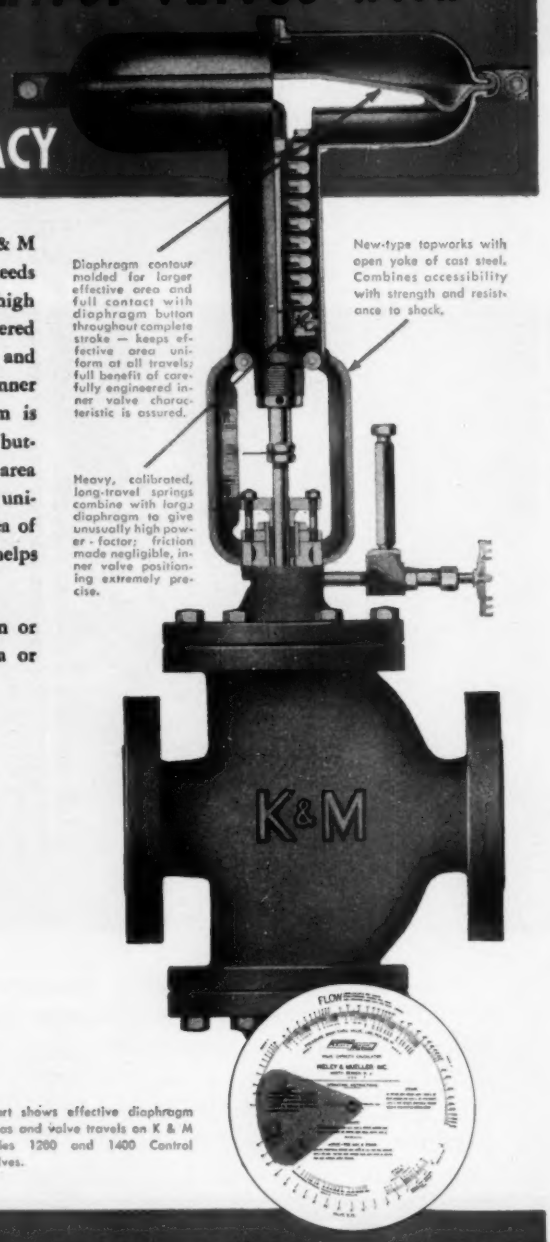
%Proportioneers, Inc.% furnishes complete chemical feeding systems for continuous automatic water conditioning. We supply systems to engineers' specifications or where required can adapt our controls to existing equipment — We will gladly assume responsibility for the complete chemical feeding system including control panels, chemical tanks, dissolvers and all other units required. Write for Brochure SM-9020.

% PROPORTIONEERS, INC. %

Write to %PROPORTIONEERS, INC., 354 Harris Ave., Providence 1, R. I.

Technical service representatives in principal cities of the United States, Canada, Mexico and other foreign countries.

K&M The Control Valves with GREATER POWER for GREATER ACCURACY


Diaphragm contour molded for larger effective area and full contact with diaphragm button throughout complete stroke — keeps effective area uniform at all travels; full benefit of carefully engineered inner valve characteristic is assured.
New-type topworks with open yoke of cast steel. Combines accessibility with strength and resistance to shock.
Heavy, calibrated, long-travel springs combine with large diaphragm to give unusually high power-factor; friction made negligible, inner valve positioning extremely precise.
K&M

The Diaphragm Motor of the far-advanced K & M Control Valve is designed for the more exacting needs of modern process industries. An unusually high power-factor is obtained by the carefully-engineered relationship of large effective diaphragm area and heavy, calibrated spring; friction is negligible, inner valve positioning more precise. The diaphragm is specially designed for constant affinity with the button contour; this assures a uniform effective area throughout the complete valve stroke, thus more uniformly accurate control. The unusually large area of the diaphragm in relation to the valve size also helps assure more precise control.

K & M motors are available for direct action or reverse action without change in effective area or stroke.

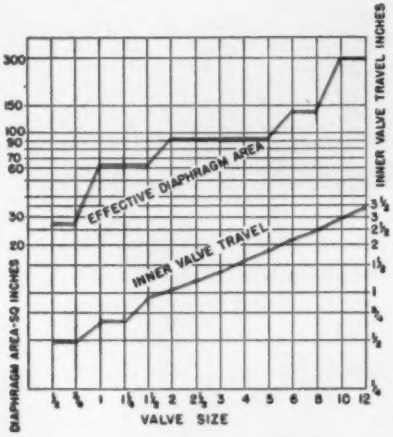


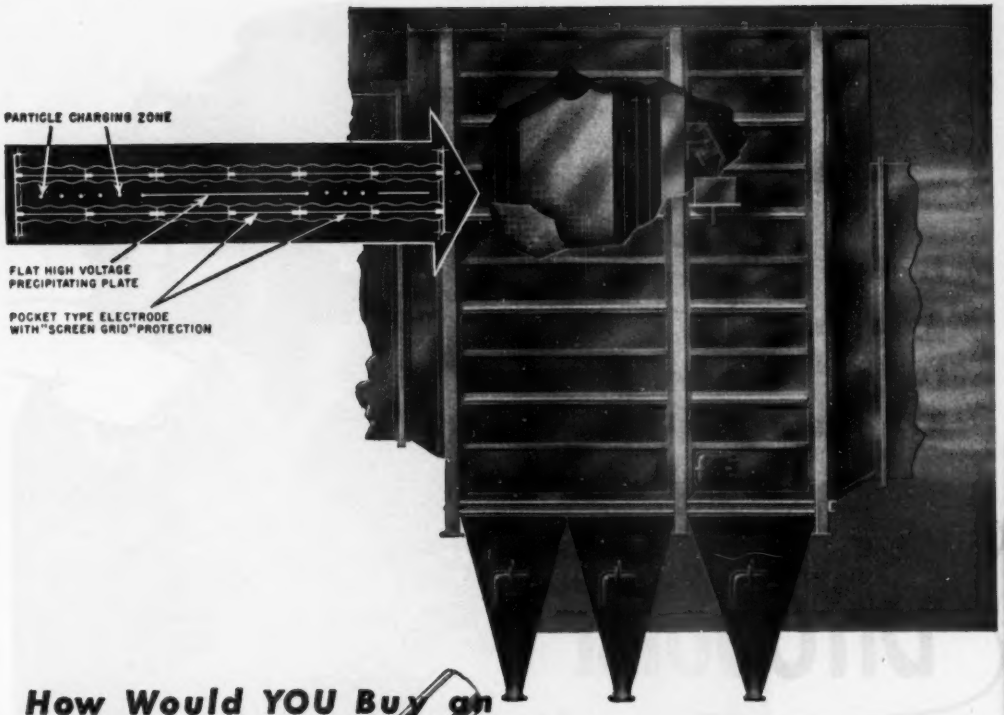
Chart shows effective diaphragm areas and valve travels on K & M Series 1200 and 1400 Control Valves.

KIELEY & MUELLER

Established 1879

2021—43rd Street North Bergen, N. J.

This extremely accurate circular slide-rule type K & M valve capacity calculator includes correction scales for steam quality, liquid and gas specific gravity and a flowing temperature scale for gases. Sent without charge in response to a request on your business stationery.



How Would YOU Buy an

ELECTRICAL PRECIPITATOR?

The basic elements of all electrical precipitator units are fundamental. All require a shell or casing with an inlet and outlet, the charging electrodes, precipitating or collecting electrodes, some form of rapping device, and a high voltage power supply.

The design of these elements, however . . . and their application to the process of electrical precipitation, is the governing factor between mediocrity and startling success.

It is highly important then, that the specifying engineer thoroughly investigate the refinements and latest developments on these basic elements and their overall effect on operating efficiency of the precipitator he is considering.

An investigation will indicate that the Aerotec Electrical Precipitator is far advanced in the four basic steps of precipitation:

1. Charging the particle.
2. Forcing charged particle to collecting electrodes.
3. Releasing the electrical charge.
4. Deposition in storage hopper.

Aerotec high voltage electrodes are subdivided for maximum effectiveness in charging and precipitating functions. Highest precipitating force is developed between flat plates, which provide a uniform field of high intensity.

To reduce the possibility of reentrainment of particles in the gas stream, Aerotec has developed a new "pocket type" collecting electrode. This unique design insures a dead zone surrounding the electrodes for maximum efficiency on both coarse and fine dusts. Release of carbon particles by induced charge, and loss of performance due to "backionization" are reduced to a minimum by this exclusive Aerotec design. Alternate rapping of the collecting electrodes reduces emission and minimizes stack "puffing" during rapping periods.

The Aerotec electrical precipitator is an ideal secondary for the Aerotec Mechanical Design 3 RAS, a combination that assures the highest efficiency possible in dust collection . . . an efficiency that will meet the most stringent dust requirements of today . . . and tomorrow.

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Project & Sales Engineers

THE THERMIX CORPORATION

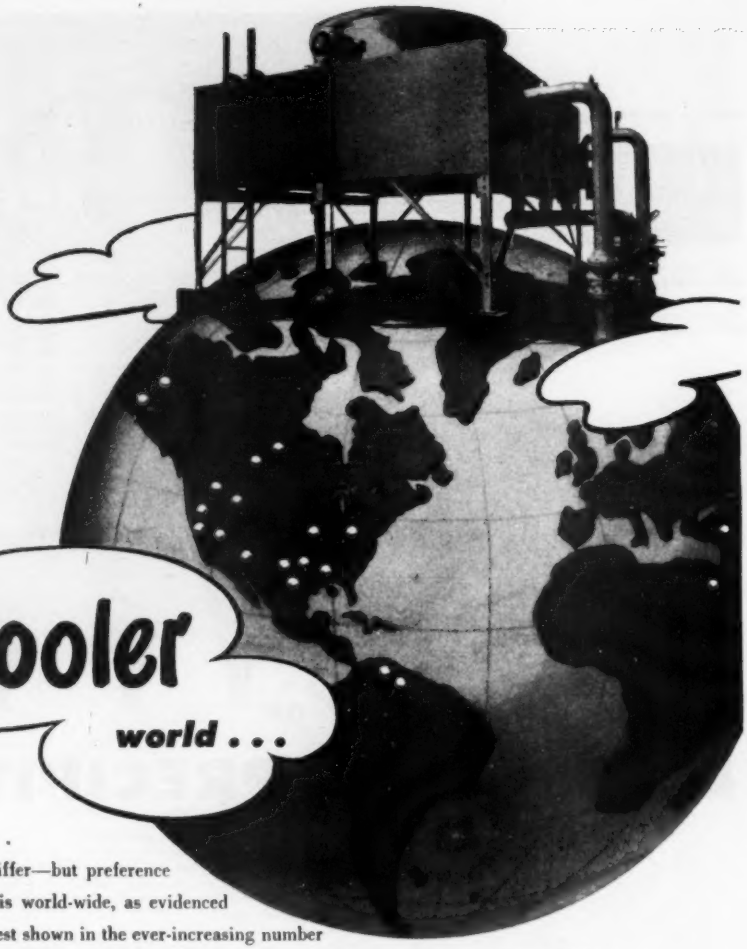
Greenwich, Conn.

(Offices in 28 principal cities)

Canadian Affiliates: T. C. CHOWN, LTD., 1440 St. Catherine St., W., Montreal 25, Quebec

THE AEROTEC CORPORATION

GREENWICH, CONNECTICUT



from Arizona to Arabia

it's a DriCooler *world . . .*

Climates vary . . . cooling requirements differ—but preference for Marley DriCoolers is world-wide, as evidenced by the exceptional interest shown in the ever-increasing number of DriCooler installations throughout the world. Consider all factors — weather conditions, fluid to be cooled, horsepower required, influence of corrosion, and many more — and you'll find that Marley offers you the best, most economical dry cooler for your specific job.

This is so because Marley makes a *complete* line of DriCoolers in a wide range of capacities and designs; because each Marley DriCooler is *engineered for the job,* whether it be to cool jacket water in the Arctic or lube oils in the burning desert.

There's a Marley application engineer in every major city, whose services and experience are yours for the asking. Call your Marley man for full details or write for Bulletin DC-50.

Also producers of
AQUATOWERS
VAIRFLO TOWERS
DOUBLE-FLOW TOWERS
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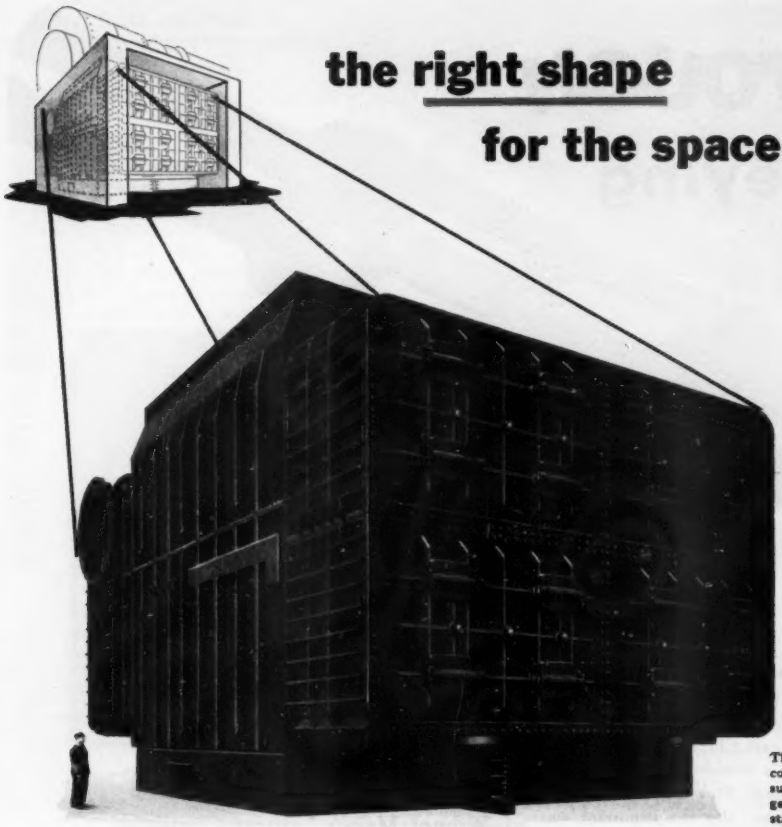
SPRAY NOZZLES

MARLEY

The Marley Company, Inc.
KANSAS CITY 15, KANSAS

the right shape

for the space available



This giant Rectangular Condenser, containing 90,000 sq ft of cooling surface, serves a 150,000 kw turbo-generator at a mid-western central station. The compactness of the I-R design made it possible to fit the cube-shaped space available.

that's one of the reasons why

I-R RECTANGULAR CONDENSERS

give you so much more kw per cubic foot of available space

Waste space has no place in a modern steam plant —particularly in the crowded quarters below the main turbine floor. And with Ingersoll-Rand Rectangular Condensers, you use all of the available space *most efficiently*—for two important reasons.

First—the compact, rectangular condenser shell is designed to *fit the rectangular space* beneath the turbine.

Second—these Rectangular Condensers have the same *high-heat-transfer design* that have made Ingersoll-Rand's condensers the standard of space-saving economy since they were introduced in 1922. This design, pioneered by I-R, provides positive control of steam flow through a low-friction-loss tube nest, eliminating "drone" surface and making all tubes work at peak condensing efficiency.

I-R Rectangular Condensers also cut installation time and expense. For they are completely assembled and tested in the factory . . . then shipped either in one piece or in flanged sections that can be bolted together without field fitting or strength welding.

These compact rectangular units were first introduced in 1946 to meet the increased demand for space-saving condensers. They are now serving, or being built for, more than 5 million kw of generating capacity. Your Ingersoll-Rand representative will gladly discuss this and other new developments in the power field with you.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

584-4

COMPRESSORS — AIR TOOLS — ROCK DRILLS — TURBO-BLOWERS — CONDENSERS — CENTRIFUGAL PUMPS — — DIESEL AND GAS ENGINES

for TOUGH Conveying Jobs...

Wilmot CHROME-MANGANESE Chain

Made of an alloy steel containing 12-15% manganese and 2% chrome, Chrome-Manganese chain is specifically designed for use where abrasion is especially severe.

Tests show that, under abrasive conditions, Wilmot Chrome-Manganese chain outlasts 2 to 3 standard chains of carbon steel. Work-hardening increases its Brinell from 220 to 450.

Standard Wilmot cast Chrome-Manganese steel chain, as listed below, is furnished with pins of heat-treated drop-forged steel. Pins may be obtained in cast Chrome-Manganese; also the important wearing parts, sprockets, sprocket teeth, and traction wheels.

MADE FROM CHROME-MANGANESE STEEL

Size	App. Pitch	Average Ultimate Strength	Weight Per Ft.
458	4"	48,000	3.5
468	4"	80,000	8.25
678	6"	85,000	6.75
698	6"	140,000	13.0
998	9"	140,000	10.5
9118	9"	230,000	17.0
9148	9"	325,000	28.0

Everything for Your Conveyor

As the originators of Rivetless drop-forged steel chain, Wilmot

Wilmot Makes Largest Choice of Drop-Forged Chain & Attachments

stocks it in the largest choice of sizes available: 3" to 10½" pitches; average ultimate strengths to 460,000 lbs. Largest choice of chain attachments; cast iron or steel flights, sprockets, traction wheels, take-ups, shafting, bearings, casings, trough; for coal, sludge or ash conveyors.

Send for BULLETIN C-502

WILMOT ENGINEERING CO.

HAZLETON, PA.
Plant: WHITE HAVEN, PA.

Wilmot Coal Preparation Equipment: Hydrotators • Hydrotator-Classifiers • Hydro-Separators • Simplex Jigs Crushing Rolls • Sizing Shakers • Bucket Elevators • Conveyors • Car Hauls • Keystone Rivetless Chain, etc.

WILMOT BUILDS BETTER BREAKERS

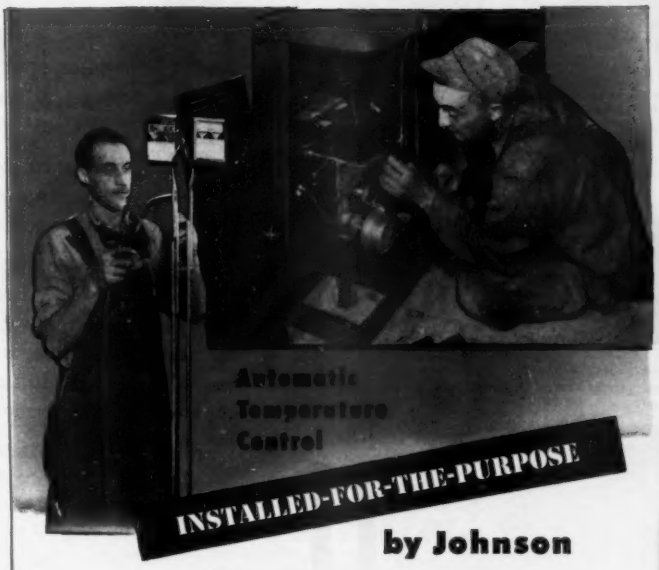
JOHNSON CONTROL in FINE BUILDINGS EVERYWHERE

• **General Service Building, University of Michigan, Ann Arbor, Michigan:** Both economy and comfort are assured by 588 Johnson *Dual* Thermostats, providing individual room control. Johnson *Dual* Control maintains proper temperatures in occupied rooms and, at the same time, insures reduced economy temperatures in all areas which are not in use.

• **100 Park Avenue, New York City:** More than a thousand Johnson *Heating-Cooling* Thermostats control over three thousand Johnson Valves in the air conditioning units in this modern office building — one of New York's finest.

• **Roosevelt Hotel, New Orleans, La.—** A Johnson Selective Room Thermostat permits the guests in each of this hotel's 900 rooms to choose any temperature between 65° and 78°. A Johnson Mixing Damper admits air, at exactly the right temperature, from double ducts above the corridor ceilings.

• **The Shamrock Hotel, Houston, Texas:** More than 900 Johnson Room Thermostats enable the occupants of each room of this four-square-block hotel to select any temperature between 68 and 80 degrees. Johnson Outdoor Master Controls regulate the temperature of the primary air which is supplied to the unit air conditioners throughout the building.



INSTALLED-FOR-THE-PURPOSE

by Johnson

Going even further than manufacturing automatic temperature control equipment and planning each system for the exact purpose which it is to serve! Those activities are only two-thirds of the complete Johnson chain of responsibility. The final step is the *installation* of the apparatus, which also is done by members of the nation-wide Johnson organization. Installed-for-the-purpose, to fit each particular job!

A unique corps of Johnson mechanics does the installation work. The members of this distinctive group are stationed at strategic locations in each of the company-owned branch office territories, to carry out the instructions of the Johnson staff of branch managers and field engineers. Johnson mechanics are Johnson's own men, devoting their entire time to the specialized work which they have been trained to perform. They are temperature control craftsmen, with a practical background in the pipe-fitting trade.

To serve the best interests of users of Johnson automatic temperature control systems is the objective which is attained by the policy of a complete "chain of responsibility." Manufacturing—planning—installing! Undivided interest, from start to finish, is centered in one highly-specialized organization. And yet, there is full cooperation with consulting engineers who are retained by owners or their architects and with their heating and air conditioning contractors... Ask a nearby Johnson engineer for recommendations which will solve *your* temperature control problems. JOHNSON SERVICE COMPANY, Milwaukee 2, Wisconsin. Direct Branch Offices in Principal Cities.

Johnson

Automatic Temperature and Air Conditioning

Control

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

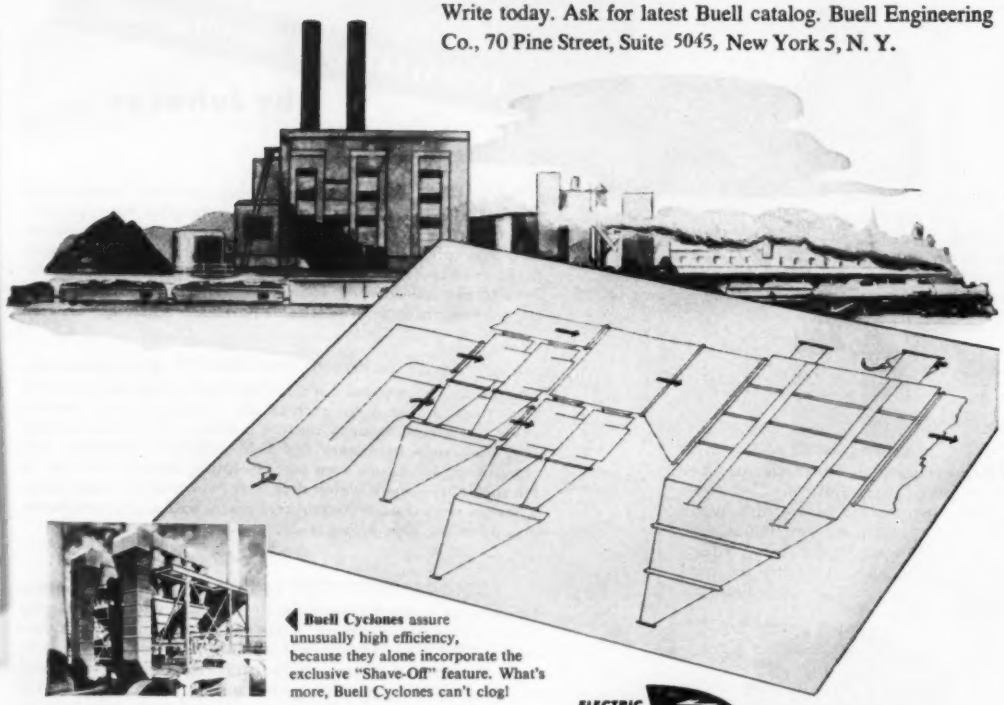
TOP TEAM FOR PEAK FLY ASH COLLECTION

Industrial engineers agree that the ultimate in Fly Ash Collection Efficiency is best achieved when you team up a mechanical collector with an electric precipitator.

Such highly efficient combination systems for the recovery of Fly Ash in your plant are products of Buell—for years, a leader in the science of dust collection.

How to help you achieve peak efficiency in Fly Ash collection is the prime function of Buell engineers. These men, backed by years of experience in weighing the factors which determine the most efficient and economical equipment for each installation, will be pleased to discuss your particular problems at your convenience. No obligation, of course.

Write today. Ask for latest Buell catalog. Buell Engineering Co., 70 Pine Street, Suite 5045, New York 5, N. Y.



Buell Cyclones assure unusually high efficiency, because they alone incorporate the exclusive "Shave-Off" feature. What's more, Buell Cyclones can't clog!

Buell 'SF' Electric Precipitator, too, boasts highly favored advantages for sustained efficiencies: StediFLOW Dust Fall assured through a carefully timed, continuous-cycle rapping mechanism. Exclusive self-tensioned Spiralectrodes for greater corona emission.

ELECTRIC CYCLONIC

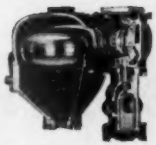
buell

Engineered Efficiency in **Fly Ash Recovery**

No. 47 Boiler Water Feeder — for hand-fired steam heating boilers up to 5000 sq. ft.

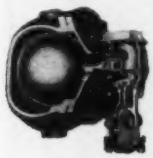
No. 47-2 Feeder - Cut - off Combination for automatically fired steam heating boilers up to 5000 sq. ft.

No. 147 Boiler Water Feeder — Similar to No. 47, but with higher feeding level for process steam boilers.

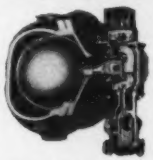


No. 247 — Same as No. 47, but for installation with 1" equalizing pipes.

No. 53-2 Feeder Cut-off Combination — Similar to No. 51-2, but built for higher pressure, up to 75 lbs..



No. 51 Boiler Water Feeder — for hand fired steam heating boilers over 5000 sq. ft.



No. 51-2 Feeder - Cut - off Combination — for automatically fired steam heating boilers over 5000 sq. ft.

No. 67 Low Water Fuel Cut-off — for low pressure steam boilers of any size.

No. 150 High Pressure Pump Control, Cut-off and Alarm — for steam boilers of any size up to 150 lbs. pressure.

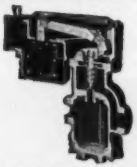
No. 157 Water Column Type High Pressure Pump Control, Cut-off and Alarm — for steam boilers of any size up to 150 lbs. pressure.

You should know ALL of these McDONNELL PRODUCTS

• You are probably familiar with the more commonly used McDonnell Products. But for those jobs you may run across from time to time that call for special equipment, you should be familiar with *all* the McDonnell liquid level controls, flow switches, and similar products listed here. They are all evidence of how intensively McDonnell has worked at "DOING ONE THING WELL." We will be glad to give you information and counsel on any special application that may arise.

McDONNELL & MILLER, INC., 3500 N. Spaulding Ave., Chicago 18, Ill.

Doing One Thing Well



No. 101 Electric Water Feeder — operated by No. 67 or liquid level switches.

No. 33 Safety Relief Valve — for hot water heating boilers. Btu. rated. ASME standard

No. E-2 Flow Switch — Completes (or breaks) circuit when flow starts or stops.

No. 21

No. 121

No. 321

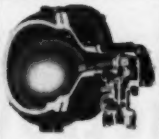
No. 421

Make-up Water Feeders—to maintain adequate water supply in receiving tanks. Nos. 21, 121 and 321 are installed right in tank openings; available in various flange forms and sizes as shown to fit existing openings. No. 421 is for external application, with equalizing piping.

No. L-8 Constant Level Valve — Maintains constant fuel oil pressure on burner.

No. 417 Snap Action Water Valve — Maintains water level in humidifier pans and in tanks.

No. 517 Water Level Control — Same as No. 417, but in die cast float chamber with cover.



No. 355 Large Capacity Float Valve — Has many uses on tanks, stills, receivers, etc.

No. 61 Low Water Fuel Cut-Off — for 1" equalizing pipe installation on low pressure steam boilers.

No. 63 Low Water Fuel Cut-off — for water or steam boilers up to 50 lbs. pressure.

No. 65 Explosion-proof Electric Controller — Underwriters' approved for hazardous locations.

No. 69 "Built-in" Low Water Cut-off — Typical of many "built-ins" for installation in tappings provided in modern boilers.

No. 469 "Built-in" Low Water Cut-off— Similar to No. 69, but with less projection into boiler.

No. 767 Low Water Fuel Cut-off — (with No. 14 blow-off) for easy installation into opening in boiler.

No. 80 Switch — Three wire high- or low-level alarm or pump control on oil storage tanks.

No. 6667 Conversion Head — for converting former cut-offs into two-switch types.

No. 154 High Pressure Pump Control — Similar to No. 150, but with open contact switches.

B-L TUBE-SUPPORTED WALLS ELIMINATE STEEL

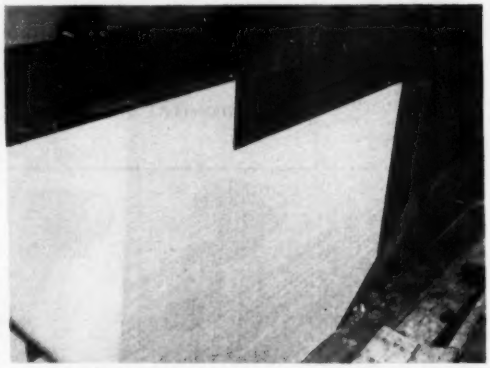
Tube-supported wall enclosures for boilers—developed and first used in 1942 by Bigelow-Liptak—eliminate supporting steel, yet provide all the advantages of unit-suspended enclosures.

All components—castings, refractories, insulation and casing—are supported by boiler tubes. Each tile is held individually and can easily be replaced. Cumulative refractory loadings and expansion are not possible, and heat losses and air infiltration are minimized.

Tube-supported walls reduce the initial cost. Not only is structural steel eliminated, but thinner refractories and economical insulation thicknesses are employed. Steel plate casings are not needed with B-L's new Texad* finish.

Construction sequence is shown in this retouched photo. Supporting castings are fastened to studs which are field welded to the tubes. Block insulation, sandwiched between layers of plastic, seals the job. Metal lath and insulation battens hold the block in place. Weatherproof Texad* provides the finish.

The crew is now fastening to the retainers the castings and refractories. After the insulation has been applied . . .



. . . **Texad* covers** the enclosure. The job goes up quickly, costs less, saves steel, holds maintenance to a minimum.

Reserve your copy of B-L's new tube-supported wall catalog. Write today on your letterhead.

*Trademark

BIGELOW LIPTAK Corporation

BIGELOW-LIPTAK

Unit-Suspended Walls & Arches

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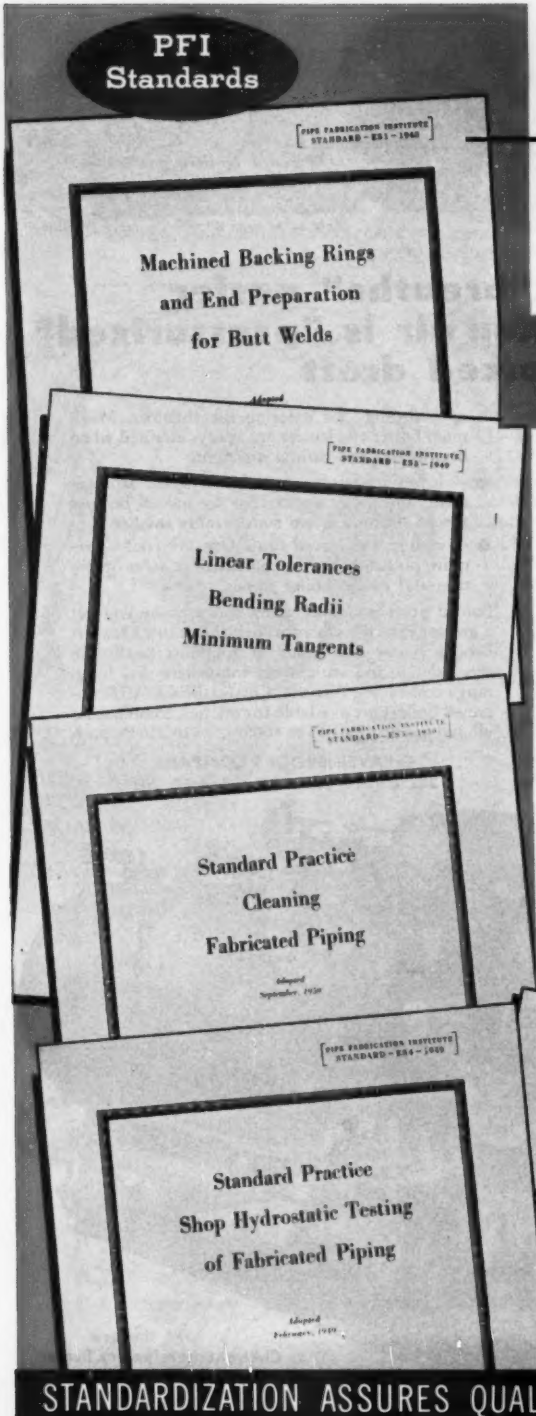

Helpful

to anyone concerned with

pressure piping

These five Standards having to do with pressure piping are now available without cost to anyone interested. They have been compiled by the Engineering and Standards Committee of the Pipe Fabrication Institute to suggest standardized design features and procedures for designers, fabricators, contractors and users of pressure piping for all purposes. These Standards are often helpful in getting better piping and maximum value per dollar of cost . . . in saving time on the drawing board, in procurement of materials and during fabrication and erection of the job.

For copies of these Standards (and additional ones to be published later) address your request to

THE PIPE FABRICATION INSTITUTE

Devoted to the Technical and Economic Problems in Piping

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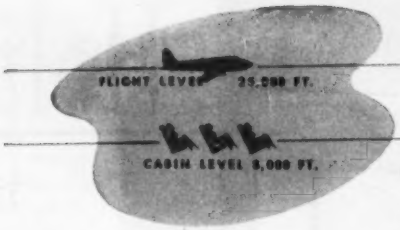
STANDARDIZATION ASSURES QUALITY and PROMOTES ECONOMY



In modern air-liners you breathe comfortably at altitudes of 25,000 ft., because your cabin is "Pressurized" — air pressure inside the plane is kept at or near normal sea level pressure.

Boilers, too, "breathe" easier when their combustion air is "pressurized" using forced draft

Cleaver-Brooks experience with thousands of steam boilers, of the self-contained type, has conclusively proven these operating advantages of forced draft:

- — because atmospheric boiler-room air is constant in temperature and therefore in density, the weight of air delivered for combustion by a forced draft fan is also constant and always gives proper air-fuel ratio (CO_2) resulting in maximum efficiency and freedom from combustion problems.
- — the electrical load, or power requirement, of a forced draft fan is at a minimum, because the fan handles a lesser volume of air.
- — low fan maintenance and longer fan life with forced draft fans since they operate with cool, clean boiler room air — no problems with high bearing temperatures and corrosion.
- — air is under pressure in the combustion chamber of a forced draft boiler, with no possibility of "diluting" air entering the chamber. Maximum boiler efficiencies are always attained when head plates and casings are tight.
- — lower initial fan cost, better space arrangement, and better appearance are gained because forced draft fans are considerably smaller.
- — casings for forced draft fans are cool — require no insulation — contribute to safer operation and cooler boiler rooms.

Forced draft is one of many reasons why you get a greater return from your investment in a Cleaver-Brooks boiler — a boiler of foremost quality in every detail and with many immediate and long-range cost-saving features. Cleaver-Brooks self-contained boilers are available for oil, gas, combination oil and gas firing — 15 to 500 hp., 15 to 250 lb. p.s.i.

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332 E. Keefe Ave., Milwaukee 12, Wis.

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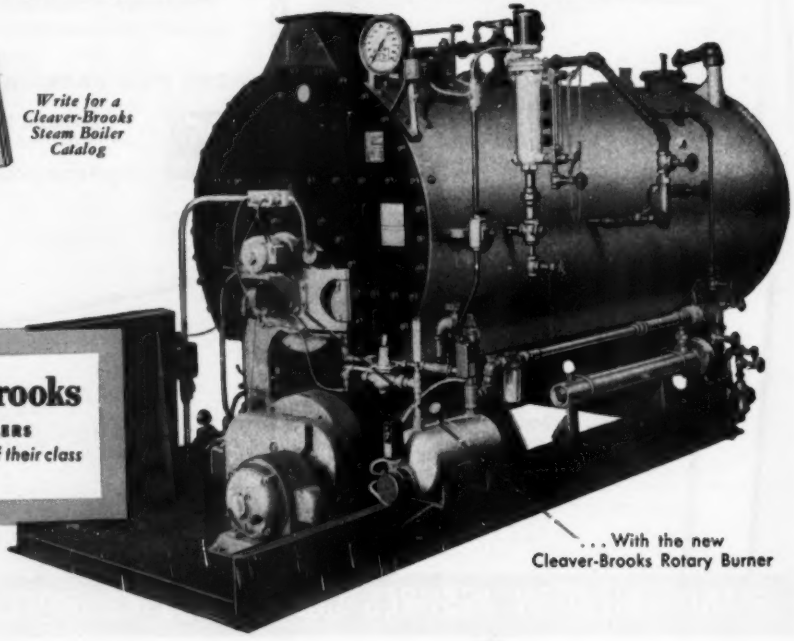
STEAM BOILERS
the first and finest of their class



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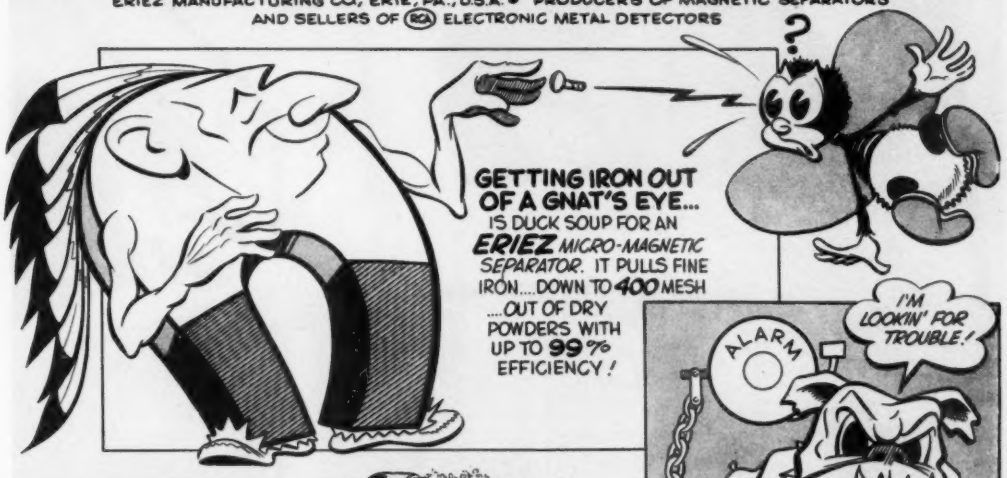

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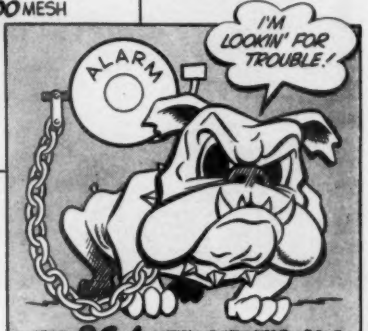

THE ***R.C.A.*** METAL DETECTOR, SOLD BY ***ERIEZ***, IS AN **ELECTRONIC WATCHDOG** THAT SPOTS ANY KIND OF METAL IN ANY KIND OF NON-METALLIC MATERIAL OR PACKAGE. WARNS BY GONG OR LIGHT, OR REMOVES THE CONTAMINATED PACKAGE.... ***AUTOMATICALLY!***

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AN ***ERIEZ*** PLATE-TYPE **ATOM**AGNET HAS MAGNETICALLY LIFTED A CIGARETTE WEIGHING ***447*** TIMES MORE THAN THE FERROUS PARTICLE HIDDEN IN IT! ....RESULTS ARE JUST AS STARTLING WITH OTHER PRODUCTS.

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HAVE REPRESENTATIVE CALL ☐ PROMPTLY ☐ WHEN IN AREA

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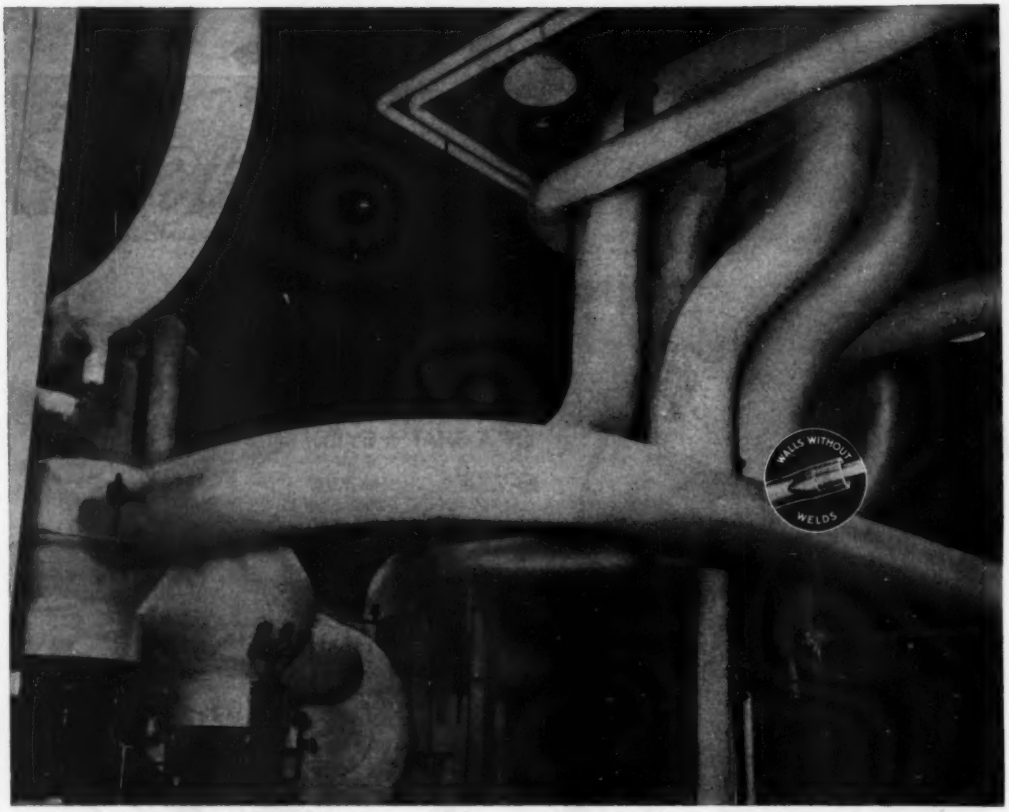

First commercial mercury-unit power plant uses Seamless Alloy Tubing

▶ The plant is the Schiller Station of Public Service Company of New Hampshire. When operating at designed rate of 40,000 Kw and using Bunker C fuel oil, the heat rate is *9,200 Btu per net Kw hr.* Temperatures are very high with resultant higher creep stresses and increased oxidation hazards.

This great advancement in design called for tubing that was completely reliable. To meet this requirement, all piping was National *Seamless* Alloy Tubing; ½ chromium, ½ molybdenum. The extra strength and uniformity of this National Seamless Tubing added the finishing touch to a beautiful job of designing.

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When you plan for future construction, check the service records of National Seamless Pipe and Tubing. It's our premier product—actually pierced from a billet of high quality steel. There are no longitudinal welds, which means absolutely uniform wall strength.

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UNITED STATES STEEL

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Herringbone SPEED REDUCERS

Single, double and triple reduction units cover every requirement in drives from 1 to 400 horsepower. Ratings and standard ratios from 1.25 to 1 to 355.8 to 1 are all shown in Catalog No. 70.

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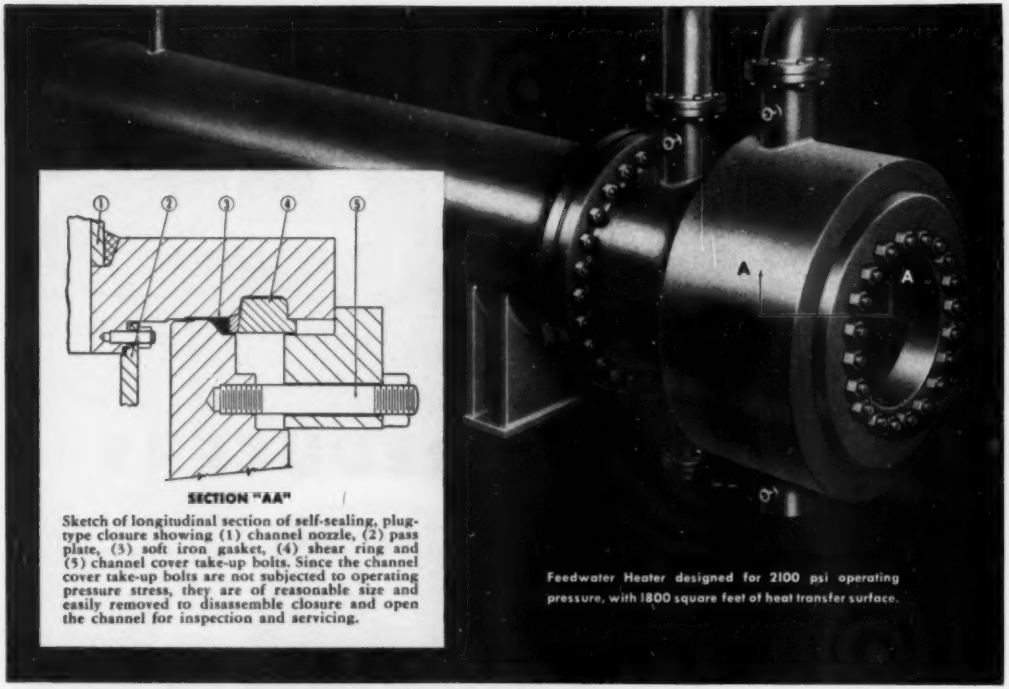

SECTION "AA"

Sketch of longitudinal section of self-sealing, plug-type closure showing (1) channel nozzle, (2) pass plate, (3) soft iron gasket, (4) shear ring and (5) channel cover take-up bolts. Since the channel cover take-up bolts are not subjected to operating pressure stress, they are of reasonable size and easily removed to disassemble closure and open the channel for inspection and servicing.

Feedwater Heater designed for 2100 psi operating pressure, with 1800 square feet of heat transfer surface.

HIGH PRESSURE FEED WATER HEATERS
Call for A.O. Smith Design Features

Pressures of 1,000 to 10,000 psi are run-of-mill specifications at A. O. Smith!

With feedwater heater pressures exceeding 2,000 psi in power plant planning, A. O. Smith pressure-vessel and heat-exchanger design features find new and extremely important application. For example:

The self-sealing closure illustrated assures a positive seal under pressure. Still, it provides for easy servicing that means low maintenance.

For 77 years, A. O. Smith has been a leading fabricator of steel products and heavy industrial equipment. The first electric, arc-welded pressure vessel ever built was made by A.O. Smith in 1925.

Since that time, A. O. Smith has developed design features and manufacturing techniques that have set the pattern for the entire process equipment field.

Power plant design engineers and consultants are invited to bring their heat-exchanger requirements to one of the finest thermal design groups in this country.

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ARMY IN OVERALLS 54,000 shopmen see to it that the Freight Cars and Locomotives of the Pennsylvania Railroad are in First-class Condition for Any Demand

With industry geared for new production records, America's railroads, which are the bone and sinew of transportation for both industry and defense, will face an all-time-high demand for freight cars.

Preparing to meet this demand, the Pennsylvania Railroad early last year launched the biggest freight car program in its history. We ordered 20,000 new freight cars costing $114 million. More than 7,000 have been delivered and put to work. All will be on the rails this year. These are in addition to more than 5,000 new cars built in the Pennsylvania's shops since January 1, 1948.

Pennsylvania Railroad shopmen also are rehabilitating 34,000 freight cars. More than 20,000 have been finished and returned to service. The others are coming along at a rate of 187 daily.

The hopper car rebuilding program alone is turning out 110 cars of 50 and 70 ton capacity every working day, equivalent to an increase in daily load capacity of 6900 tons.

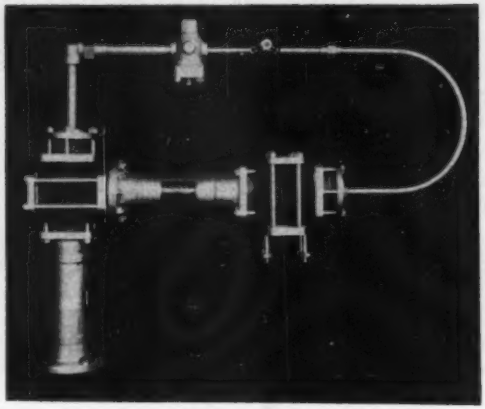
The Pennsylvania Railroad is spending a total of more than $217,000,000 for this new and rebuilt freight car program in order to be ready to serve the defense needs of the country.

PENNSYLVANIA RAILROAD

NOTES for the Power Engineer

C. H. Wheeler OF PHILADELPHIA

STEAM CONDENSERS—STEAM JET EJECTORS—COOLING TOWERS—VACUUM REFRIGERATION—HIGH VACUUM PROCESS EQUIPMENT—MICRO-PARTICLE REDUCTION MILLS—MARINE CONDENSERS & EJECTORS—DECK MACHINERY



Two-stage non-condensing impervious graphite ejector

Send for catalog 1462. It contains helpful tables and tips on Steam Jet Vacuum problems. It also describes the complete line of C. H. Wheeler Tubejets. It will be mailed at no obligation to you.

STEAM JET EJECTORS
Made of IMPERVIOUS GRAPHITE For Handling CORROSIVE VAPORS

If your vacuum equipment is inefficient due to corrosion from acid fumes, this item holds an answer to your problems.

For highly corrosive acids such as sulphuric, hydrochloric, nitric, etc. C. H. Wheeler impervious graphite ejectors are recommended. The impervious graphite is enclosed in a steel or cast iron casing to prevent breakage. It is light in weight, non-porous, with low coefficient of thermal expansion and high resistance to thermal shock. Impervious graphite is most commonly recommended for the single and two-stage non-condensing ejectors.

C. H. Wheeler Ejectors can also be furnished of other materials such as acid resisting bronze, monel and stainless steel where the corrosive action of the vapors being handled does not require the use of impervious graphite construction.

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The C. H. Wheeler Manufacturing Company's unique design of an integral reverse-flow steam condenser provides the most practical method yet devised for cleaning the tube sheet, and eliminates the need for expensive mechanical water straining apparatus. A recently issued bulletin tells how it works.

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Attach this Handy Form to Your Company Letterhead

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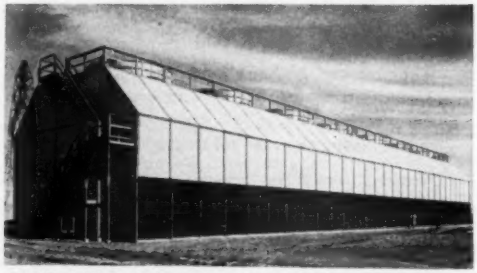
☐ "Self-Cleaning" Reverse-Flow Steam Condensers

Your Name .....

Your Job .....

(Literature will be mailed to address shown on your company letterhead)



ANOTHER TOWER FOR SAN ANTONIO
13 Cell, 55,000 GPM Capacity to be Built by C. H. Wheeler for Gibbs & Hill, Engineers & Constructors

Following construction of two 7-cell Cooling Towers at the Leon Creek Power Station of San Antonio, Texas, C. H. Wheeler has been awarded the construction of a third and larger tower. The first towers were designed for 30,000 GPM. The new tower will handle 55,000 GPM to serve a 60,000 KW generator. It is a 13-cell induced-draft tower designed for 76.5° wet bulb, taking water at 105.5° inlet and cooling it to 90° outlet. Proposed construction is 39'8" x 364' x 29'. It will resist 30 lbs. per square inch wind pressure, or 100 mph hurricane force. Gibbs & Hill, New York are the engineers and constructors on the job.

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Midwest offers a large variety of welding fittings to help *you* improve *your* piping. Many of these fittings were originated by Midwest for the purpose.

For example, the Midwest Reducing Elbow saves a third of the welding, decreases turbulence and pressure drop and improves appearance when used instead of a standard elbow and reducer. Midwest Long Tangent Elbows have a tangent or straight section at each end equal to ¼ the nominal pipe size; this saves pipe, saves time in lining up, and often saves welding. (These are in addition to ASA Type and Short Radius Elbows.) Midwest Sleeves relieve the line butt weld of all bending stress and much of the tensile stress. Midwest Saddles restore the original pipe strength and reinforce the joint.

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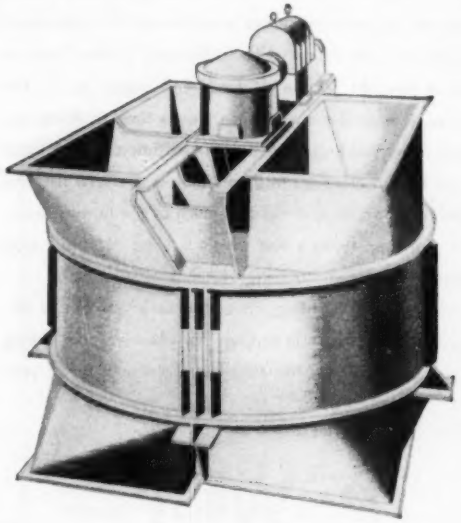
High temperature combustion air is the key factor to efficient combustion of low-grade fuels, especially coals with high ash or moisture content. With the Ljungstrom Air Preheater it is possible to obtain higher preheat more economically.

In addition, the *continuous regenerative counterflow principle* of the Ljungstrom permits reliable operation at low exit gas temperature. This assures the greatest possible heat recovery . . . reduces the amount of fuel required.

If you are planning a new installation, or modernizing your present one, our engineers will welcome the opportunity to show you how the Ljungstrom can enable you to get better results from low-grade, less costly fuels.

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves the heat is transferred from the waste gases to the incoming cold air.



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PHILADELPHIA ELECTRIC COMPANY'S 180,000 kw power station at Barbadoes Island, Norristown, Pennsylvania. The additional facilities recently constructed by the Power Department of Dravo Corporation more than triple the capacity of the original station.

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Today cost pressure keeps demanding new ways to save money. You can get at the root of this situation in your boiler room.

Whether you have one or a battery of boilers you'll find your boiler room can deliver good savings through Correct Fuel Feed — Fuel-Air Ratio, and Over-Fire Draft.

You accomplish this with CASH STANDARD Automatic Combustion Control Systems. What you actually get is more steam from your present boiler—less fuel, coal-oil-gas used—savings in maintenance. CASH STANDARD units are available in a number of variations. Combinations can be made to give you complete automatic control with all of its benefits. Size of your boiler or type make no difference.

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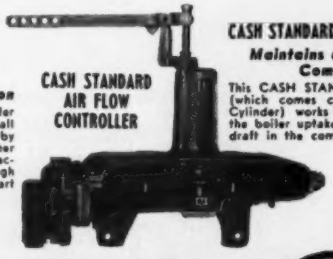
It shows applications—tells how the system works—gives you a good insight into the savings possible.

CASH STANDARD FUEL FEED CONTROLLER . . .

Automatically Regulates Fuel Feed

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion — hence, money saving.



CASH STANDARD AIR FLOW CONTROLLER

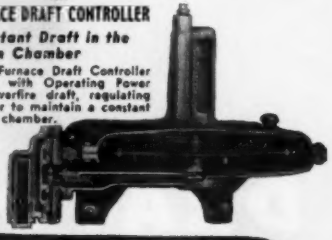
Meters the Air Needed for Combustion

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.

CASH STANDARD FURNACE DRAFT CONTROLLER

Maintains a Constant Draft in the Combustion Chamber

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.



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FOR THE WORLD'S MOST EFFICIENT TRANSMISSION BELTING

You save money and help conserve rubber with pre-tested, pre-stretched Republic Transmission Belting. Whether you use endless or roll lengths in regular or oil-resisting materials, Republic Transmission Belts are built for service and efficiency.

Every belt reflects the experienced designing skill and craftsmanship that built it and your local Republic Distributor can show you how proper application and care result in outstanding performance records.

Remember, for 50 years Republic has been *the* specialist in industrial rubber. Make Republic headquarters for all your industrial rubber requirements.

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THIS MAN WOULDN'T NEGLECT

A MACHINE IN HIS PLANT

...yet he hasn't had a Chest X-Ray!

He checks every piece of mechanical equipment he owns for wear, lubrication, efficiency.

Yet he fails to take the simple precaution of a Chest X-Ray to make sure he does not have tuberculosis. *Not because he's opposed to the X-Ray. Simply because he is not sufficiently informed—or just hasn't taken the time and trouble, or does not realize the seriousness of the problem.*

A Chest X-Ray is the first step toward detecting tuberculosis in its early stages. And in its early stages it can be cured with the least loss of time from work.

So, if you're the man above, that one simple reason should make you get your Chest X-Ray—*today*. But listen, see how serious this really is:

Between the ages of 15 and 34, tuberculosis leads all other diseases as a cause of death—although at no age are you safe from TB. Yet, if everyone does his part by getting a Chest X-Ray periodically, and the majority of cases thus discovered are followed up, we can eliminate TB entirely as a public health hazard!

Will you do your part today? Get a Chest X-Ray. It may mean your life!

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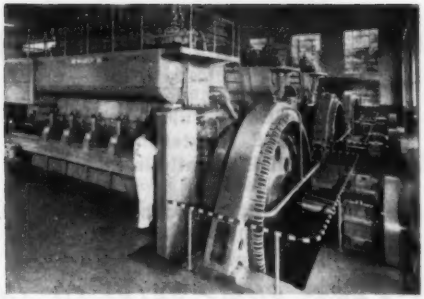
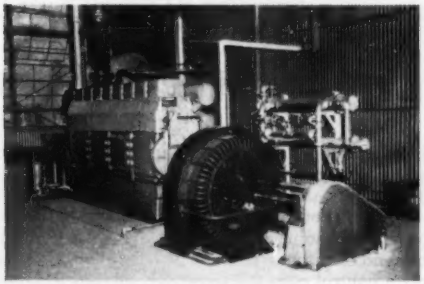
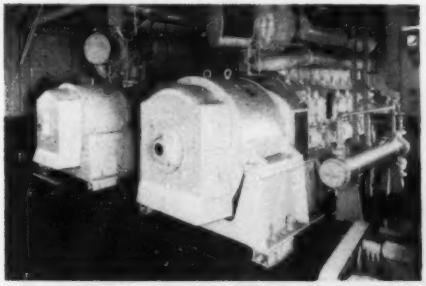


Three 2000 HP Nordberg Diesels, all equipped with Ross lube oil and jacket water coolers, in Houma, Louisiana municipal power plant.



Nordberg 720 HP (at 720 RPM) Diesel, Ross lube oil and jacket water cooler equipped, serving as standby unit for emergency power requirements of Owens-Corning Fiberglas Corp., Santa Clara, Calif.



Two of three 375 HP Nordberg Diesels, all equipped with Ross lube oil and jacket water coolers, generating power for all machinery in U. S. Engineers Mattress Laying Plant along Mississippi River. (Installation on mooring barge).

In industry, municipal power plants or aboard ship, Nordberg Diesel Engines achieve substantial savings in fuel, lube oil, labor and maintenance. "They provide the most economical answer to modern power needs," says Nordberg Mfg. Co. of Milwaukee, Wisconsin.

. . . and in meeting today's demands for adequate power at low cost, Nordberg must place as much importance on the selection of components as it does on its own engineering, design and construction. For clearly, so vital a component as a heat exchanger could well cancel out much of the efficiency of an engine, were its own performance deficient. *Dependable heat exchanger performance is relied on,* TO A LARGE MEASURE!

Therefore, throughout its wide range of two and four-cycle engines, in sizes from 10 to 9600 HP, Nordberg makes extensive use of Ross Exchangers . . . knowing full well that Ross Exchangers as built-in components assure constantly safe and effective temperatures for both lube oil and jacket water . . . and knowing, too, as other leading Diesel builders know, that the Ross reputation for dependability matches its own.

★ ***HELPFUL DESIGN DATA*** For Diesel builder or user, large or small HP ratings, the information in Ross literature will prove of extreme usefulness. Write.

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In HOMES
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– wherever dependable automatic heat is needed!

Johnson Burners give you more *usable heat* from every gallon of oil that you buy. Why? Because *they capture and utilize an exceptionally high percentage of the heat generated in combustion.* This extra "efficiency" is the product of 48 years of oil-burner research and "know how." It is paying off in homes, skyscrapers and industries all over the nation. It can save fuel oil and money for you. Let your Heating Engineer or your nearest Johnson Dealer show you why and how.

Johnson Oil Burners

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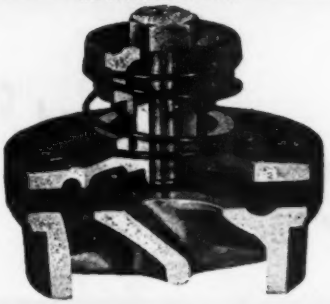

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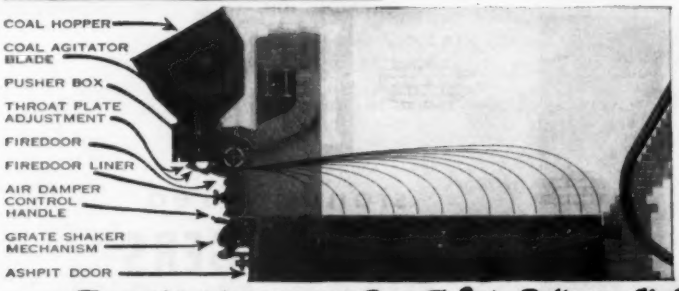

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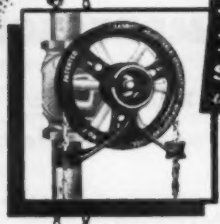

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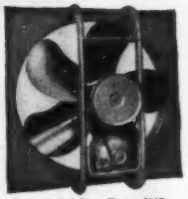

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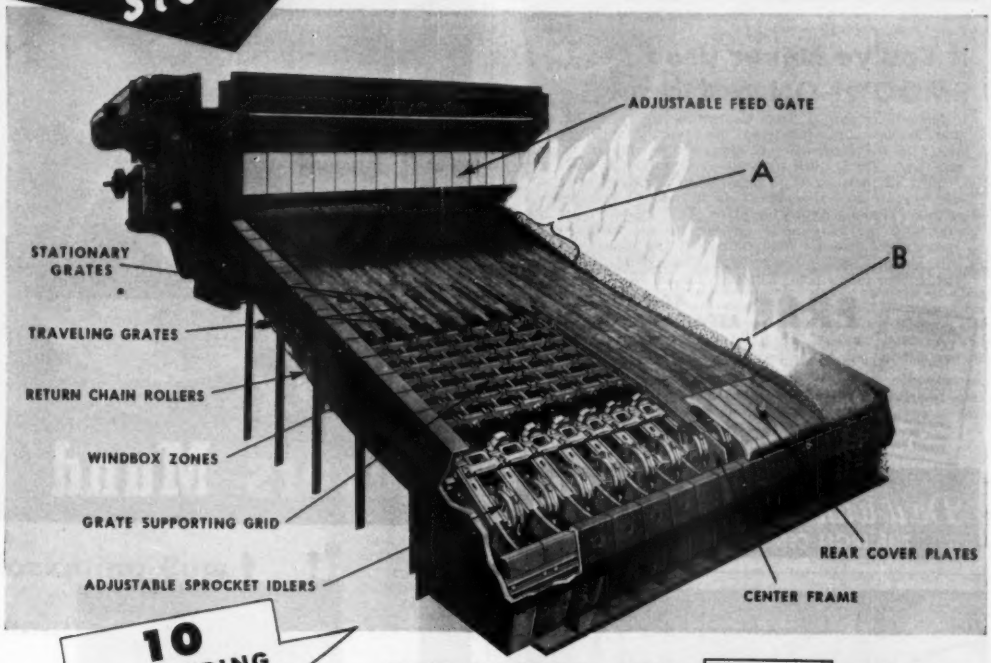

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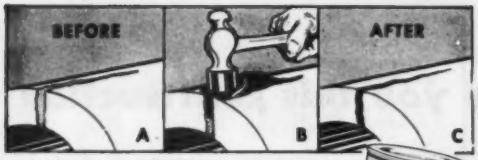

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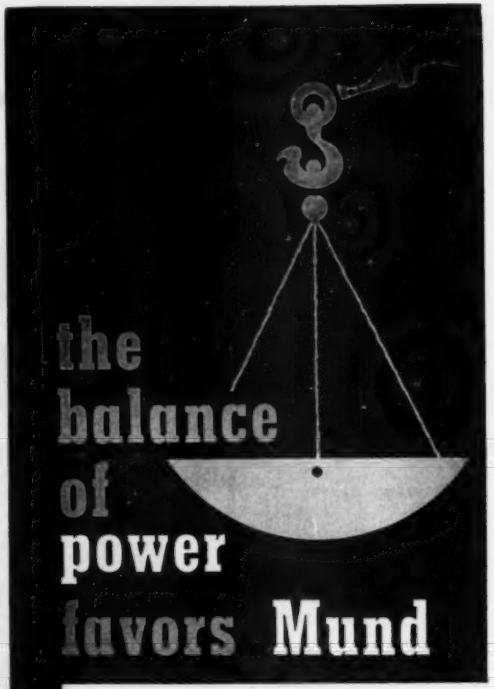

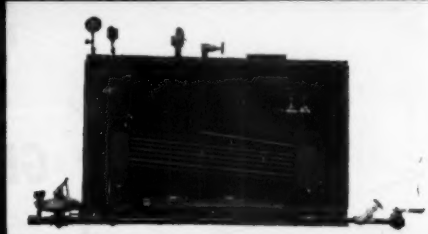

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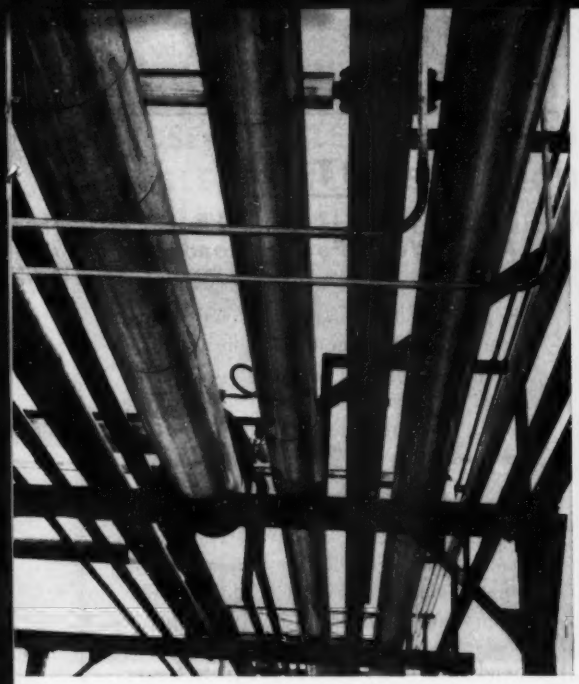

This close-up clearly shows the ribs or corrugations which add strength to Childers Jacketing and also make it form more easily around lines. Aluminum strapping and seals are a quick, inexpensive way to attach the jacketing. They can be used without any special tools and take no special training for the installers.

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You can attach Childers Jacketing around your insulated lines by one of several easy methods. The use of aluminum strapping and seals is probably the best. Sheet metal screws or Minnesota Mining's No. 471 tape can also be used.

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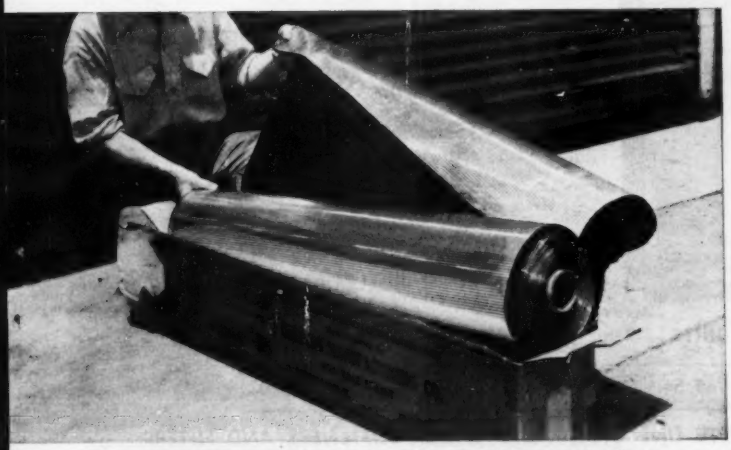

This is how Childers Aluminum Jacketing is shipped in easy-to-handle rolls. It is quite flexible, yet stands up under severe weathering.

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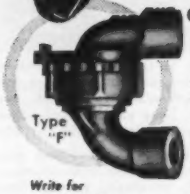

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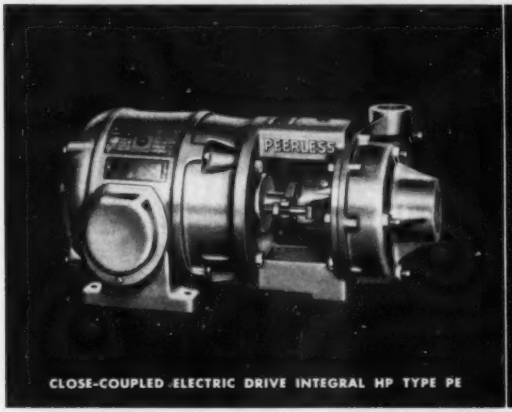

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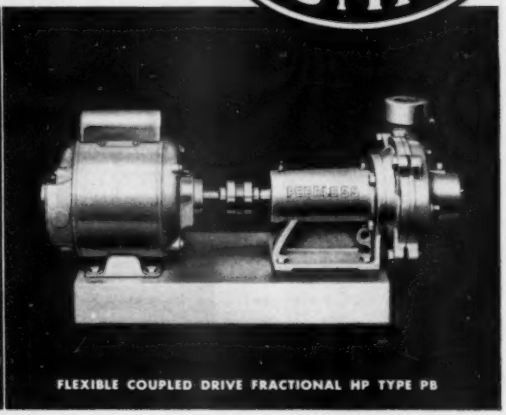

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HEADS:

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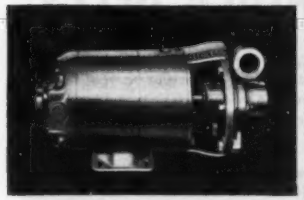
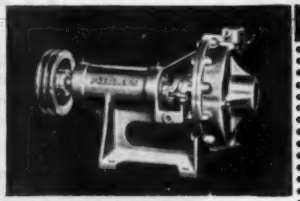


Electric drive fractional HP Type PF



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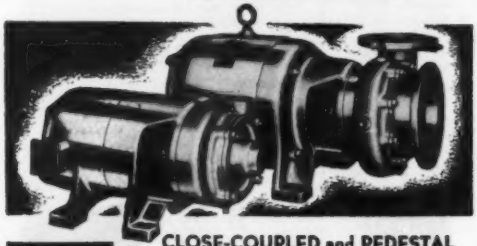

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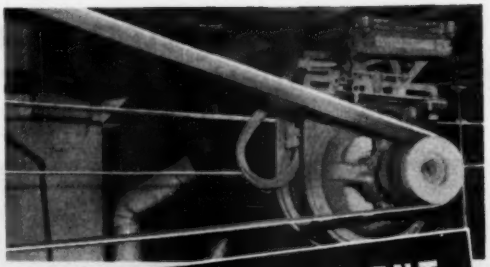

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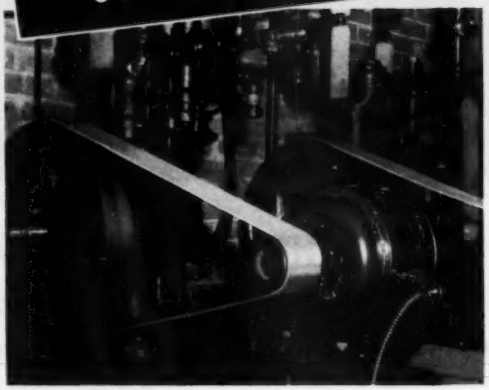

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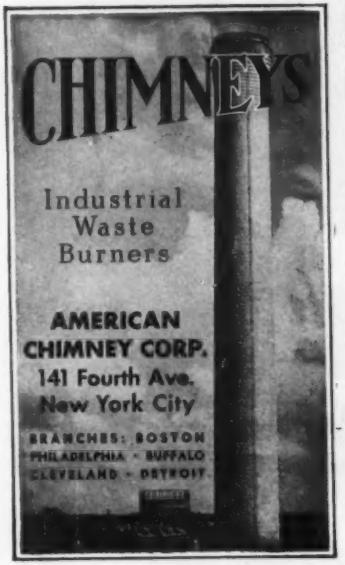

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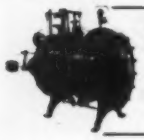

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We Must Pay As We Go

***We** must do our utmost to pay as we go for our present defense program.*

On that proposition those who speak with authority are remarkably well agreed. This editorial – the second in a series on our mobilization for freedom – sets forth in simple terms why there is this agreement.

Next year – the fiscal year beginning next July 1 – the federal government's budget calls for the expenditure of $10 billion more than is scheduled to be collected in taxes. The deficit is due to the increase in defense expenditures.

A part of this deficit can be eliminated by cutting non-essential expenditures and increasing efficiency in the defense program. There is wide agreement on this. It is the duty of the President and Congress to see that it is saved.

How the remaining deficit anticipated in the federal budget—$5 billion to $10 billion—is handled is crucial. The government can meet it by raising taxes—by paying as we go. Or it can borrow, issuing more government bonds.

Borrow Again?

We relied heavily on borrowing in both World War I and World War II. In World War I only about one-third of the expenditures of the federal government were met by taxation. In World War II about 45 percent were met in this way. The rest we borrowed. Some people ask, why can't we rely heavily on borrowing again? Why is it crucially important to avoid adding $5 billion to $10 billion to a federal debt that is already $257 billion?

Part of the answer is found in the contrast between this defense program and our all-out effort of World War II. Another part—and one that is all-important in combatting inflation—results from the rapid decline in the purchasing power of the American dollar in recent years.

We went "all out" in World War II. We put almost half of everything we produced into our military effort. Taxes high enough to pay the financial costs as incurred would have meant huge tax increases. It was feared that such increases would kill financial incentives to get "all out" production. Since we expected the war to be short, borrowing seemed a safe expedient. Price control and rationing, with wartime patriotism to give them effective support, were relied upon to keep in check the inflationary pressure created by borrowing rather than taxing.

Our present defense program is scheduled to take a much smaller share of our production, but to take it over a much longer period. At its peak, the program as now planned will take only about 20 percent of our total national production. But, to use General Bradley's phrase, "the conditions under which we labor may persist for ten, fifteen or twenty years."

What About Controls?

For a period of any such duration it would be foolhardy to expect that the sort of controls we had for the few years of World War II could hold in check the inflationary pressure created by not paying as we go. It would be as foolhardy as it would be for a family to plan on borrowing to pay the expenses of a member discovered to be afflicted by a chronic ailment which might last a long lifetime.

Obviously, the only safe thing to do in such a case would be to adjust the family budget so that the expenses of the illness would be paid currently.

Our heavy reliance on borrowing in World War II had consequences which block a successful repeat performance.

If the borrowing had been done by persuading individuals to transfer their savings into government bonds, relatively little inflationary pressure would have been created. What the government would have spent with the proceeds of such bond sales would have been subtracted from the money individual consumers could spend.

But much of the borrowing was done from banks. That course expanded the amount of money available to the government without any offsetting subtraction of money from the hands of individuals. Thus, when direct price controls were removed after the war, this bottled-up purchasing power contributed to a price inflation which has cut purchasing power of the American dollar about in half – and decidedly changed the attitudes of the American people toward that dollar.

During World War II, Americans in general believed that:

The war would not last long.

The dollar would hold its value, and even gain value after the war.

Many wonderful new products would be available in the postwar period.

Today the American people have:

Seen the value of their dollars melt away fast.

Been assured that, at best, we may have a 10-15-20-year pull ahead.

Been warned not to expect a postwar paradise anytime soon.

One result of these changed attitudes is a notable lack of enthusiasm for government bonds on the part of individual investors. This is indicated by the fact that since Korea redemptions of E bonds have exceeded sales by about $600 million. Another result is a continuing rush to convert dollars into physical goods and equipment or claims on them. This trend weighs against financing the prospective federal deficit by borrowing from individuals.

Borrowing from banks to meet the deficit would again add fuel to inflation.

The prospective deficit is due to federal expenditures for military goods. Even if they are not blown up or shipped abroad, these goods will not be available to civilians. But the money paid to those who produce military goods will still be available to bid up the prices of civilian goods. Thus, at a time when people show relatively little disposition to save dollars, a menacing inflationary pressure – an inflationary gap, the economists call it – will be created.

If our fight against inflation is to be successful this gap must be closed by taxes. We need to do other things, too, for inflation has many different causes. Credit expansion must be effectively controlled. Production of civilian goods must be increased as much as possible by eliminating waste and inefficiency. But a pay-as-we-go tax program is basic to a successful attack on inflation. And inflation – unless it is checked – could wreck our defense effort.

We cannot pay as we go merely by soaking harder the corporations and those in the upper income brackets.

As the President's Council of Economic Advisers has reported, "by far the largest part of the additional revenue must come from the middle and lower tax brackets. These are the brackets in which the great bulk of the income is located."

Taxes Can Attack Inflation

By spreading tax increases broadly, taking small amounts from many people, inflationary pressure would be effectively reduced. It is the expenditures of the great mass of people, rather than the small numbers in the upper income tax brackets, that create most of the pressure. Moreover, it is possible to increase taxes broadly without killing the economic incentives to produce. Maintaining these incentives is essential to the success of the defense effort.

Our elected representatives cannot be expected to be enthusiastic about a pay-as-we-go tax program. It involves increasing the taxes of the great body of their constituents, an operation completely lacking in political glamour. However, such a program also involves the integrity of the American dollar. And that is absolutely essential to the success of the defense program. We shall be very foolish if we do not let our leaders know that we want them to do everything possible to pay as we go.

McGraw-Hill Publishing Company, Inc.

Marsh valves and traps throughout . . . IN CHICAGO'S MODERN FLORSHEIM PLANT

HEDRICH-BLESSING STUDIO

This new plant of the Florsheim Shoe Co. has been described as one of Chicago's architectural masterpieces. Only the best was good enough for this model establishment . . . and that is why Marsh Traps and Valves were used throughout.

The heating system contains a large number of Marsh Float and Thermostatic Traps of indicated types, and radiation is equipped with hundreds of Marsh Packless Radiator Valves and Radiator Traps.

Ask for facts about Marsh valves, traps and venting devices —time tested equipment, preferred by the most discriminative heating men.

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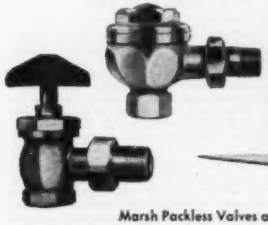
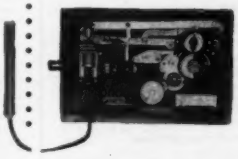


Marsh Packless Valves and Radiator Traps are used throughout in the Florsheim plant.

Marsh No. 12 Float and Thermostatic Trap — typical of many float and thermostatic traps, used in the Florsheim plant, which include Marsh No. 8 and No. 14 Traps.



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Excellent location in Southern California. Generous allowance for travel expenses.

Write today for complete information on these essential, long-term positions. Please include resume of your experience & training. Address inquiry to Director of Engineering.

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(Continued on the opposite page)

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(Continued from the opposite page)

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The latest date for the receipt of tenders is now to be 30th June, 1951.

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WANTED! AT ONCE!

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1 or 2—Used B & W Boilers, (no other make will do) 1,000 HP each, must be ASME Code, and in A1 condition.

State full particulars, location and lowest price in first letter.

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These are 4 bearing units, ball bearing, drip-proof construction, with DC panels.

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400 or 450 or 500-H.P. 2300/3/60/1200-RPM motor, squirrel cage or synchronous.

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No.	Each	PH	Prim.	Sec.
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1 Electric Motor, 400 H.P., 450 RPM, 3 phase, 60 cycle, 440 volts, slip ring.

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No lengths too long or too short
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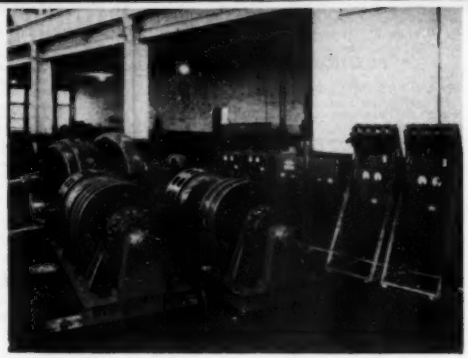

2—400 KW Elliott 240 volt, compound wound, 1200 rpm D.C. Generators, 600 HP Elliott synchronous motors, with 3/60/2300-6900 volts, Automatic reduced voltage starting panel, D.C. Switchboard—In stock—completely rebuilt. Immediate Shipment.

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2	1000	G.E. new	K	3/60/2300	1800
1	700	G.E.	ATI syn.	480	1200
1	600	West.	CS	2300	900
2	600	West.	Syn.	440	257
1	500	Al. Ch.	SC	2300	1800
1	400	G.E.	Syn.	360/2300	450
1	400	G.E.	MT412	2200	450
1	400	West.	CW	440	514
1	350	West.	CW	440	600
1	350	G.E.	MT18	3/60/2300	400
1	350	G.E.	IM	220	600
					alipring
1	315	G.E.	Syn.	2200	720
1	250	West.	CS	2300	1200
1	200	West.	MW	440	600
1	150	Ideal	Syn.	220	1200
1	125	Cent.	SC	440	1800
1	100	G.E.	K	220/440	1200
2	100	West.	CS	220	1800
1	100	Cent.	SC	220	1200
1	100	C.W.	SC	200	900
1	100	A.C.	Sl. Rg.	440	720
2	100	G.E.	Syn.	440	300
1	75	Wagner	BM	440	900
1	75	West.	CW	440	1200
1	60	Ideal	SC	220	1200
1	60	West.	C.W.	440	720
3	50	A.C.	SC	220	900
1	50	West.	CS	440	3600
1	50	West.	C.W.	220	900
1	50	G.E.	I.M.	440	600
2	50	Cent.	SC	220	1200
1	40	G.E.	MT-536	440	900
1	30	G.E.	MT-532	440	900
2	25	G.E.	MT-332	440	900

Direct Current — 230 Volt

2	1½	West.	B	220	1750
3	1½	G.E.	BD	220	1750
1	2	G.E.	BC24B	230	1700
2	2	West.	CD	230	1150
1	2	A.L.	AW5C	230	900
1	3	Diehl	S	230	850
1	3	West.	SK	230	1150
3	5	West.	S	230	550
					(Crane Motor)
1	5	G.E.	RC	230	1100
1	7½	G.E.	RC	230	850
1	7½	West.	SK43	230	1150
1	7½	A.C.	E75	230	1150
1	7½	G.E.	BD	230	3450
1	10	G.E.	CD	230	1250
1	15	Cr. Wh.	CCM	230	850
1	15	G.E.	RC	230	1150
1	20	West.	SK	230	1100
1	20	G.E.	RC	230	800
1	25	West.	SK	230	900
1	25	El. Dyn.	S	230	800
1	25	G.E.	RC	230	3450
1	75	West.	SK	230	800
1	250	Cr. Wh.	DR	230	1900

Direct Current — 230 Volts
Variable Speed

1	5	El. Dyn.	SH	230	550/1650
1	5	Diehl	SH	230	670/1200
1	5	G.E.	RLC	230	400/1600
1	7½	G.E.	R.E.	230	450/1350
1	10	G.E.	RF-10	220	400/1200
1	10	G.E.	RLC	230	500/1200
1	10	G.E.	RF	230	525/1525
1	10	Ele. Dyn.	S	230	425/1275
1	15	Burke	AM7	230	300/1200
12	15	G.E.	RF	250	300/1500
1	15/20	Ele. Dyn.	15-S	230	300/900
1	20	Ele. Dyn.	S	230	550/1650
1	25	Cr. Wh.	CMC	230	850/1725
1	25	C & C	L	230	250/1000
1	40	West.	SK	230	500/1500
1	50	Cr. Wh.	CMC	230	300/1200
1	50	G.E.	RF-16	230	300/1200
1	100	G.E.	RF-17	230	450/900
1	150	West.	SK-201	230	450/900

Direct Current — 115 Volts

1	1	West.	SK	115	1750
1	1½	G.E.	CVC	115	550
1	3	G.E.	CD-45	115	1150
1	3	G.E.	RC	115	1700
12	10	G.E.	CDM NEW	115	1750
1	10	Cr. Wh.	CM	115	825
1	12½	Ideal	D	125	700
1	40	Ideal	D	125	1760
1	75	Cr. Wh.	CMC	115	410
1	85	G.E.	RC	115	1100

MOTOR GENERATORS

1—1000 KW G.E. MPC ATI 550 Volt, 3 phase, 60 cycle, 2300 volt

1—600 KW West. 3 unit set, 250 volt D.C. 3/60/440 A.C. Syn.

500 KW Crocker Wheeler Type CCD, 230 volt D.C. 720 rpm, Generator on Baseplate with 750 KVA Crocker Wheeler 3/60/2300 syn. motor, complete with Syn. Motor Starting Panel, Generator panel.

7—600 KW G.E. MPC-ATI, 250 volt, 3/60/2300/720 rpm

1—150 KW West. (1936) 250 V. D.C. 3/60/220-440-2300/1200 rpm

1—100 KW Al. Ch., 250 V. D.C. 3/60/440/1200 rpm

1—100 KW G.E. 125 V—3/60/220/1200 rpm Syn.

1— 80 KW G.E. 240 V—3/60/440/1800 rpm

1— 50 KW G.E. 250 V—3/60/240/1200 rpm

1— 50 KW G.E. 125 V—3/60/220/1200 rpm

1— 40 KW Ideal 125 V—3/60/220/1200 rpm

1— 40 KW West. 240 V—3/60/220-440/1200 rpm Syn.

1— 7½ KW G.E. 125 V—3/60/220-240 v

1— 90 HP Sheppard Power Unit with clutch and radiator, elec. starting

1— 25 HP Fairbanks Morse Diesel, 325 rpm horizontal

2— 60 HP Chrysler Diesel Ind-3, 1500 rpm

2— 60 HP Buda diesel power unit—radiator

1— 94 HP Cummins Power Unit—1600 rpm

1—150 HP Cooper Bessemer, 900 rpm

DIESEL GENERATORS

1—2500 KVA General Motors, complete plant, 3/60/2300 with 2300 to 230/460 transformers, cooling system, starting equipment, switchboard, can demonstrate on foundations. Immediately available.

1—480 KVA Superior (1941) 3/60/440/360 rpm

1—225 KVA G.M. Twin 6-71, 3/60/440. NEW 1941

200 KW Fairbanks Morse, 250v., D.C. 720 rpm 8 cylinder, 4 cycle, Complete—1940

200 KW G.E.-Fairbanks Morse, 720 rpm, 3/60/220/440—8 cyl., 4 cycle—1940

200 KVA Cummins LI 400 3/60/440/900 rpm—Radiator—Sw. Bd.

100 KVA Cooper Bessemer 8 cy 900 rpm, 3/60/220

56 KVA G.E.-Climax Gas Port, 3/60/220/1200 rpm

1—50 KW G.E. 250 V .D.C. Gen with Cummins Mod HMR—6 cyl, 4 cy, 1200 rpm diesel

40 KVA NEW Chrysler 3/60/220—2 units

30 KW Buda, 3/60/220/1200 rpm

20 KW Le Roi Gasoline—1/60/110-220 volt

PHILADELPHIA'S LARGEST MACHINERY DEALERS AND EXPORTERS

TELEPHONE
GArfield 6-1150

CABLE ADDRESS
OBRIEN-PHILA

THE O'BRIEN

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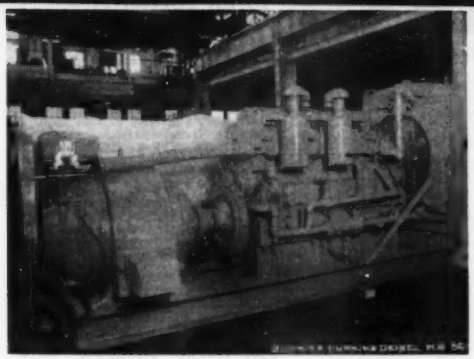
ALL YOUR MACHINERY NEEDS



200 KVA Cummins Model LI-600, diesel generator, 240-480 volts, 3/60/900 rpm direct connected to 6 cylinder, 4 cycle, diesel engine with switchboard.

INTEGRITY

For 37 years The O'Brien Machinery Company has faithfully upheld the highest standards of business practice while serving our country's industry.

TURBO-GENERATORS

1—780 KVA West. 2400 volt, 3/60/3600 rpm, 200 psi. Condensing
1—625 KW West. 3/60/2300/3600 rpm, 125 Lb. psi, 6 Lb. B.P.
1—600 KW G.E. Extraction 360/2300/250 psi., 80 lb. & 16 lb. extraction. Surface Condenser new 1940
1—500 KW G.E.-Moore (1936)—Non-Cond. 3/60/2300/3600 rpm, 180 psi, 35 Lb. B.P.
1—400 KW West. 3/60/480, 150 psi., 10 Lb. B.P.
3—300 KW West. (1938) Non-Cond. 250 Volt D.C. 150 psi, 10 Lb. B.P.
1—300 KW G.E. 2300 volt, 3/60/3600 rpm—Curtis—4 stage turbine 200#—Condensing
1—300 KW Elliott (new 1941) 250 Volt D.C., 150 Lb. I.S.P., 20 Lb. B.P.
1—300 KW G.E. 3/60/2300/100 p.s.i. 0-15 Lb. B.P.
1—160 KW West. 3/60/220/3600 rpm, 125 Lb. psi., 10 Lb. B.P.
1—160 KW Ridgeway 4 Valve Steam Engine Generator, 3/60/220
1—100 KW NEW 3/60/220 150/200 psi. 0/30 Lb. B.P.
1— 75 KW G.E. Non-Cond. 125 V. D.C.
1— 75 KW G.E. 125 V. D.C. Non-Cond. 150#
1— 35 KW G.E. 125 volt D.C., 3600 rpm

A.C. GENERATORS

KVA	Make	Phase	Cycles	Volts	Speed
1250	West.	3	60	440	1200
1—750	G.E.	3	60	480	1200
500	West.	3	60	440	900
2—500	West.	3	60	440	257
375	West.	3	60	440	360
300	G.E.	3	60	2200	720
300	G.E.	3	100	550	600
200	Al. Ch.	3	60	220	900
125	E.M. (NEW)	3	60	220	900
100	G.E.	2	60	220	900
100	Ideal	2	60	220	1200
62.5	Burke	3	60	220	1200
32.5	G.E.	3	60	220	1200
15	Ideal	2	60	220	1800
15— 7.5	G.E. (NEW)	1	60	120	1800

TURBO BLOWER SPECIAL

3—Ingersoll Rand Type CVS—20" New 1941-42 12,000 cfm, 3.25#, 3550 rpm—direct connected to 250 HP G.E. 3/60/440/3600 rpm motors. 2 units cast iron—1 fabricated steel.

STEAM ENGINES

1—400 HP Ames Vertical Uniflow 4 cyl. 12 x 12—360 rpm
60—30 HP NEW Troy Vertical Steam Engines 7 x 6, 150 Lb. 500 rpm Throttling Governor

PUMPS

1—20" Lea Courtney, 20,000 gpm, 200 ft. Turbine Drive 175/250 PSI condensing
1—20" Lea Courtney, 10500 gpm, 100 ft. 400 HP, 3/60/970 rpm
1—20" De Laval—Double Suction, 10,500 gpm, 114 ft. 400 HP, 3/60/870 rpm
1—16" Lea Courtney, 17,000 gpm, 200 ft. Turbine Drive—175/240 psi condensing
1—16" Lea Courtney double suction, 8150 gpm, 102 ft. 250 HP 3/60/1200 rpm
1—14" Worthington Double Suction 5000 gpm, 112 ft. 200 HP 3/60/440/900 rpm
1—14" Worthington Double Suction, 6800 gpm, 200 ft. 3/60/440/1150 rpm
2—10" De Laval double suction, 1700 gpm, 95' TNH, 60 HP, 3/60/440/1750 rpm
1—10" Wheeler, 3500 gpm, 80 ft. with 100 HP, 3/60/440/1760 rpm motor
2— 8" De Laval Double suction, 2500 gpm, 200 ft. with 200 HP 3/60/2300/1760 rpm motor
1— 8" De Laval Dble Suction, 1500 gpm, 231 ft. TNH. with 150 HP, 3/60/440/1750 rpm
2— 6" Worthington Dble Suction, 1200 gpm, 40 ft. TNH. with 15 HP, 3/60/440/1750 rpm
1— 4" Lawrence 550 gpm, 150' TNH, 40 HP 3/60/1750 rpm
2— 2" Worthington NEW 2UB1 Double Suction with 10 HP, 3/60/220/1750 rpm motor

BOILERS

1—200 HP Keeler Horizontal Long Drum Water Tube 160 Lb. used very little
1—352 HP Keeler Water Tube ASME Mechanical Stoker—200 Lb.
2—360 HP Springfield boilers same as above.
1—390 HP Springfield Sectional 300 PSI, Water tube boilers—superheaters, sidewater wall construction. Combustion Type E stoker, Green fuel economizers, feedwater heaters, coal unloading and conveying equipment. Boiler feed pumps, etc.
1—540 HP Keeler Water Tube 250 Lb. ASME Steel encased Riley Pulverizer and oil burner equipment—with side water walls
1— 25 HP McKee Gas Fired 100# Dowthern Vapor Generator

SWITCHBOARDS—CONTROL PANELS AC/DC

We Will Build to Your Specifications—Any and All Types of Control Panels—Wire or Write Your Specifications.

TRANSFORMERS

Qu.	KVA	Make	Type	Phase	Pri.	Sec.
1	100	Red Line	OISC	1	2300	230/460
2	150	West. NEW	OISC	3	6900	208/120
1	150	West.	OISC	1	2400	240/120

AIR COMPRESSORS

2—12,000 CFM Ingersoll Rand Turbo Comp. 3.25# pressure, 250 HP 3/60/440/3600 rpm md
1—8000 CFM Cooper Bessemer, 150/400 psi direct motor 2700 HP Syn. 3/60/2300—NEW

1690 CFM Sullivan 100" Class WN 2, 12 x 12½ x 16 Two Stage Syn. motor 250 HP 3/60/2300 volt. Exciter, Starting Equipment—Can be Inspected Operating.

1—1050 CFM Ingersoll-Rand ES-1, 17¾x18, 50 psi, 275 RPM, V-belt
1—880 CFM Worthington syn. motor drive 150 HP, 3/60/440/277 rpm Size 17x10½x12 with starting equipment, aftercooler.
1—734 CFM Sullivan Angle Class W18, Single Stage 13x13x8, 60 Lb., 300 RPM, v-belt, 100 HP
2—528 CFM Chicago NSB, 100 Lb., 285 RPM, V-belt, 14x12
2—368 CFM Ingersoll ER-1, 285 RPM, 100 psi., 50 HP direct gear, M.D., 3/60/220
1—360 CFM Schramm Vertical V belted on steel base, 75 HP Motor 3/60/220
3—300 CFM Schramm Vert. Direct conected 50 HP GE 3/60/220-440/1200 rpm on base (1945)
1—277 CFM Chicago PB4 Air Cooled 50 HP V-Belt Motor Drive
1—254 CFM Chicago Pneumatic NSB—125# Belt-Drive 40 HP.
1—245 CFM IR-10x10 ER-1, 125 Lb.
1—215 CFM Penna. 3A—10x8, 50 Lb.
2—173 CFM Ingersoll ER-1, 9x8, 300 RPM, 100 Lb., V-belt

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MACHINERY CO.

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WAGNER
CERTIFIED REBUILT

ELECTRIC MOTORS & GENERATORS
Backed by 45 Years of Quality & Service

M-G SETS

KW	Mfr	Input V	Output V
300	G.E.*	440 AC	275 DC
200	Whse*	2300 AC	275 DC
200	Gen. Elec.*	220/440 AC	125 DC
150	Gen. Elec.*	2300/440 AC	600 DC
150	Cr. Wh.*	220/440 AC	250 DC
105	Century b.b.	220/440 AC	70 DC
100	Allis Ch.* (2)	2300/440 AC	60 DC
100	Whse.	230 DC	220 AC
100	Whse.	220/440 AC	230 DC
100	Gen. Elec.	220/440 AC	125 DC
100	Gen. Elec.	220/440 AC	250 DC
75	Gen. Elec. (2)	220/440 AC	250 DC
75	Gen. Elec. (3)	220/440 AC	125 DC
65	Whse.	220/440 AC	250 DC
60	Gen. Elec.*	220/440 AC	60 DC
50	Allis Ch. (2)	220/440 AC	125/250 DC
50	Gen. Elec.	220/440 AC	250 DC
45	Cr. Wh. b.b.	220/440 AC	125 DC
40	Whse. (2)	220/440 AC	125 DC
40	G.E.	220/440 AC	250 DC
35	Cr. Wh. b.b.	220/440 AC	125 DC
35	G.E.	220/440 AC	48 DC
35	Gen. Elec.	220/440 AC	250 DC
25	G.E. b.b.	220/440 AC	125 DC
20	Whse. b.b.	220/440 AC	600 DC

*Syn. motor drive.

D. C. MOTORS

HP	Mfr	Type	Volts	Speed
150	Cr. Wh. TEFC	32H	230	900
100	Whse.	8K181	230	450/900
100	Gen. Elec.	C	230	575/1000
100	Gen. Elec.	CD125	230	850
75	Gen. Elec.	BC	230	1000
75	Northw'n	K29	230	1750
75	Whse.	8K160	230	850
75	Cr. Wh. b.b.	CMC-HH	230	1150
60	Cr. Wh.	56H	230	700
60	Reliance b.b.	651T	230	750
50	Cr. Wheeler	CMC	230	1750
50	Gen. Elec.	B.C. 14	230	1050
40/60	Whse.	8K160	230	500/1000
40	Gen. Elec.	BC-33	230	1150
40	Cr. Wheeler	EH	230	1750
40	Whse.	8K110L	230	1750
40	Whse (2)	8K130	230	850
35/50	Gen. Elec.	CD123	230	575/1150
30	Whse.	8K110L	230	1150
25/30	Cr. Wh. b.b.	FH	230	575/1725
25	Whse.	8K150	230	300/1200
25	G.E. b.b. (2)	CD93	230	1150
25	G.E. b.b. New	CDM93	115	1150

- **EXPLOSION PROOF MOTORS—**
- **GEARHEAD MOTORS, AC & DC.**
- **FREQUENCY CHANGERS.**
- **CIRCUIT BREAKERS, AC & DC.**
- **SPEED REDUCERS.**

D. C. GENERATORS

HP	Mfr	Type	Volts	Speed
300	Gen. Elec. 1brg.	DMC	275	720
130	Cr. Wh. b.b.	8SH	250	1150
105	Century b.b.	1500 amp	70	1200
100	Gen. Elec.	CD	250	1200
100	Gen. Elec.	C	250	750
100	Gen. Elec.	DLC 125/250		675
75	Gen. Elec.	BC	250	1200
75	Gen. Elec.	BC36	125	1200
65	Whse.	8K169	250	1100
60	Gen. Elec.	LC	250	700
50	Allis Ch. (2)	RW 125/250		1200
50	Gen. Elec.	B.C. 14	250	1200
50	Cr. Wheeler	50H	250	900
45	Cr. Wh. b.b.	FH	125	1750
40	Whse.	8K	250	1200
25	Gen. Elec.	CD	250	1500
25	G.E. b.b. New	CDM93	125	1450

A. C. MOTORS—25 CYCLE

HP	Mfr	Type	Volts	Speed
150	Whse.	HP	440	500
60	Allis Ch.	ARY	440	1500
30	Gen. Elec. int.	MTC5537	440	750
30	Gen. Elec.	I-K	440	750

A. C. GENERATORS—60 CYCLE

KVA	Mfr	Type	Volts	Speed
625	Gen. Elec.	ATB	2300	450
625	G.E. 25 cycle	ATB	2300	300
300	Allis Ch.	3 brg.	240/480	300
300	Gen. Elec.	ATB	600	720
275	G.E. 25 cycle	ATI	480	750
250	Whse.	G	2400/480	600
250	Gen. Elec.	ATB	240/480	900
225	Gen. Elec.	ATB	240/480	600
187	Gen. Elec.	ATB	240/480	900
156	Elec. Machy.	3 brg.	240/480	514
125	Gen. Elec.	ATB	240/480	720
125	Gen. Elec.	ATB	240/480	1200
100	El. Machy.	B.B.	2400	900

A. C. MOTORS—SLIP RING
3 Phase 60 Cycle 220 or 440 Volts

Qu	HP	Mfr	Type	Speed
1—	600	Gen. Elec.	I-M	360
1—	500	G.E. 3 brg.	I-M	450
1—	400	Gen. Elec.	I-M	514
1—	300	Allis Ch. 2300V.	ANY	720
1—	300	Whse. 2300V.	I-M	1800
1—	300	Gen. Elec. 2300 V.	M5866	900
1—	300	G.E. b.b. New	CW	600
1—	250	Allis Ch. 2300V.	ANY	514
1—	250	Cr. Wheeler	SR	600
1—	200	Cr. Wheeler	SR	600
1—	150	Gen. Elec.	I-M	1200
1—	150	G.E. 2200/4000V.	I-M	1200
1—	150	Gen. Elec.	I-M-17	450
1—	125	Gen. Elec.	I-M-15	720
2—	100	Gen. Elec.	I-M	1800
1—	100	G.E. Vertical	MT553	1200
1—	100	Gen. Elec.	1M-13A	514
1—	100	Northwestern	HWT5A	900
1—	100	Gen. Elec.	I-M	720
1—	100	Cr. Wheeler	SR	600
1—	100	Northwestern	HW	1200
1—	75	Gen. Elec.	MT558	600
1—	75	G.E. 2200V.	MT556	720
1—	75	Gen. Elec.	MT537	1800
1—	75	Whse. 2200V.	CW	600
1—	60	G.E. TEFC b.b.	M-6326	720
1—	60	Fair. Morse	BV	720
1—	60	Whse. 2200V.	CWT16C	900
1—	50	Allis Ch.	ANY	900
1—	50	Howell	8R437	1200
1—	50	Gen. Elec. int.	ITC5013	600
1—	50	Gen. Elec.	MT536	1200
2—	40	Whse.	CW636A	1200
1—	40	Allis Ch. b.b.	ARY	1200

A. C. MOTORS—SYNCHRONOUS

HP	Mfr	Type	Volts	Speed
600	Gen. Elec. (2)	TS	2200	514
300	Gen. Elec.	ATI	2300/550	450
300	Whse.	G	2200/440	600
300	Gen. Elec.	ATI	440	720
275	G.E. 25 cycle		2200/440	750
250	Gen. Elec.	TS	220/440	300
220	G.E. 3 brg. SPF	ATI	220/440	600
200	G.E.	TS	220/440	150
200	G.E. SPF	ATI	220/440	900
190	El. Machy.	3 brg.	220/440	514
150	Gen. Elec.	ATI	220/440	720
150	El. Machy.	ATI	220/440	360
120	Burke b.b. SPF		220/440	1200
130	Gen. Elec.	AC10	2200/440	1200
100	American b.b.	YGH	220/440	900
125	El. Machy.	B.B.	2400/4800	900

A. C. MOTORS—SQUIRREL CAGE
3 Phase 60 Cycle 220 or 440 Volts

Qu	HP	Mfr	Type	Speed
2—	500	Fair. Morse 2200V.	HS	1200
1—	350	Gen. Elec.	I-K-17B	600
1—	325	Gen. Elec.	KT428	400
1—	300	G.E. 2200V.	KTP561	1800
1—	300	Gen. Elec.	I-K	600
2—	250	Whse.	428	1200
1—	250	Gen. Elec.	FT549AZ	1800
1—	200	Whse. b.b. NEW	CS875	1800
1—	200	G.E. 3 brg.	I-K	400
1—	200/112G.E.		KP550	1200/900
1—	150	Ideal 2200V.	A-227	1800
1—	150	Gen. Elec. TEFC b.b.	K6333B	1200
1—	130	Gen. Elec. 2300V.	IK-13A	1800
1—	125	Con. 2200V. b.b.	HD	1800
1—	125	P.M. 2200V. vertical	UH-14D	1200
2—	125	G.E. 2200V. TEFC	K6326	3600
2—	125	Reliance b.b. New	5058	1800
2—	100	Gen. Elec.	KT556	900
1—	100	Ideal	AA	600
1—	100	Gen. Elec.	I-K	720
1—	100	Gen. Elec. b.b. NEW	K5048	1800
1—	75	Fair. Morse b.b.	HJQ	600
1—	75	Reliance b.b. NEW	C5084	900
2—	75	Reliance b.b. NEW	C505	1800
1—	75	G.E. TEFC 2200V.	K-6325	900
2—	75	Gen. Elec.	KT543	1200
2—	75	Reliance b.b. NEW	C505	1200
2—	75	Gen. Elec.	I-K-14	600
1—	75	G.E. Expl. Pf.	K6325	1200
1—	60	Gen. Elec.	I-K	600
3—	60	G.E. 2200V.	KT533	1800
1—	60	G.E. 4000V.	KG584	1200
2—	60	Reliance b.b. NEW	B504	1800
1—	60	Reliance TEFC NEW	C505	1200
1—	60	Whse. H.T.	C8594	1800
1—	50	Rel. TEFC New	B1415	1200
3—	50	Gen. Elec.	KT546	720
1—	50	Gen. Elec.	KT536	450
2—	50	G.E. Vertical	KT545	720
2—	50	Reliance b.b. New	CC594U	900
1—	50	L.A. 2200 V. Ex. p.f.	E5048	1800
3—	50	Gen. Elec.	KT536	1200
1—	50	Whse.	C8	1200
1—	50	G.E. NEW b.b. HT	KG405	1800
2—	50	Reliance b.b. NEW	C445	1200
1—	50	Whse. hi-lip	WL907	900
1—	50	Allis Ch. 2200V.	AB445	1800

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Send for Complete Stock Lists

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1435 W. RANDOLPH ST. MO-rse 6-7405 CHICAGO 7, ILLINOIS

MOTOR GENERATORS

1—1000 KW G.E. Syn. 250 V. 720 RPM
2—300 KW G.E. Syn. 250 V. 1200 RPM
1—200 KW WEST. Syn. 250 V. 1200 RPM
1—200 KW ELLIOTT Syn. 125/250 V. 1200 RPM
1—100 KW G.E. Ind. 250 V. 1200 RPM

ROTARY CONVERTERS

1—500 KW G.E. Syn. 250 V. 1200 RPM HCC, 6 Ph., 60 Cy. Transformers.
2—300 KW G.E. Syn. 250 V. 1200 RPM HCC, 6 Ph., 60 Cy. Transformers.
1—300 KW WEST. Syn. 250 V. 1200 RPM 6 Ph., 60 Cy. Transformers.
1—150 KW G.E. Syn. 250 V. 1200 RPM HCC, 6 Ph., 60 Cy. Transformers.
1—150 KW WEST. Syn. 250 V. 1200 RPM 6 Ph., 60 Cy. Transformers.
1—150 KW RIDGWAY Syn. 250 V. 1200 RPM 6 Ph. 60 Cy. Transformers.

ARMATURES

1—500 KW G.E. 250 V. MPC Gen. 900 RPM
1—300 KW G.E. 600 V. HCC Conv. 1200 RPM
1—150 KW G.E. 250 V. MPC Gen. 1200 RPM

WALLACE E. KIRK COMPANY
502 Grant Bldg., Pittsburgh 19, Pa.

COMPRESSORS
VACUUM PUMPS

The World's Best Rebuilts
Since 1902

AMERICAN

STATIONARY — PORTABLE
ELEC. — GAS — DIESEL — STEAM
BUY OR RENT

LOW PRESSURE
1570 CFM — 50 PSIG Rebuilt
Pennsylvania Duplex Unit—
Direct Connected or Belt Drive.
INSPECT OUR PLANT

American Air Compressor Corp.
Dell Ave. & 47 St., N. Bergen, N. J.

FOR SALE

2—NEW—"WHEELER" 8,000 Sq. Ft. SURFACE CONDENSERS arranged for 2-pass operation

4—NEW—"WESTINGHOUSE" Size C-43 (Multi-Stage) AIR EJECTORS—SUITABLE FOR UNITS UP TO 8,000 Sq. Ft.

Attractively priced — Detailed Specifications available upon request.

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2—404 H.P. Springfield sectional header
1—250 H.P. Stirling, Class-H. Cass Stoker
2—400 H.P. built in 1942 (used 3 years) COMPLETE PLANT, forced & induced draft fans, stacks, Spreader stokers & oil burners.

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Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

PENN MACHINERY COMPANY
Jackson, Miss.

LAND can help you meet your Production Schedule with

Guaranteed Electrical Equipment

1 YEAR GUARANTEE

1 to 50 HP
NEW and REBUILT
TEFC—EX. PR.—Drip proof and Splash proof
IN STOCK

SQUIRREL CAGE MOTORS
3 phase

H.P.	Make	Type	Speed
200	G.E.	KT557	1760
200	G.E.	KF-6335	880
150	West.	CS	580
150	G.E.	IK	870
150	Century (3)	SCN	1150
125	Century (7)	SCN	1150
100	Wagner (NEW)	XP	1150
100	G.E.	K-544	1175
100	Century (3)	SCN	1150
100	West.	CS	870
100	Al.Ch.		690
75	West. (2)	CS-654C	1750
75	Cont.	B.B.	1750
75	G.E. (3)	K-505	1175
75	G.E.	IK	900
75	G.E. (3)	KT-352	865
75	West.	CS	720
60	F-M	TEFC (2)	1750
60	Howell	SCR	1800
60	West. (2)	CS-607	880
60	Rel. (2)	AA	875
60	G.E.	KT-346	865
60	G.E.	TEFC(GH)	427
50	G.E.	FTR-523	3600
50	Elliott	196	3450
50	West.	CS	1740
50	West.	XP	1150
50	G.E.	KF-445	1170
50	West.	CS-642C	1160
50	West. (3)	CS	870
50	G.E. (2)	IK	870
50	G.E.	FTR-542	870
50	West.	CS	690
40	G.E.	TEFC(GH)	561

SLIPRING MOTORS
3 phase

H.P.	Make	Type	Speed
600	Cr.Wh.	131AQ	507
500	G.E. (2)	IM	450
500	Ideal		1150
225	Wagner	25 cy.	710
200	G.E. (2)	IM	1170
150	Wagner	31VRN	900
75	West.	CW	1150
75	West.	CW	720
75	G.E.	MT556	900
75	G.E.	IM	690
60	West.	HP	850
60	Al.Ch.		690
50	G.E.	MT-536	1150
50	West.	CW	1150
50	L. A.	OGH	870
50	F-M	BV	500
50	Al.Ch.	ARY	575
50	G.E.	IM	490

SYNCHRONOUS MOTORS

H.P.	Make	Type	Speed
475	West.		720
300	G.E.	ATI	900
250	G.E.	TS	900
250	Ideal	SMN	360
200	Ideal	SMW	257
200	West.	Unused	900
180	G.E.	ATI	900
150	G.E. (2)	TS	1200
150	G.E.	ATI	900
125	G.E.	ATI	900
135	West.	G	1200
135	Ideal		1200
100	Elec.Prods.		1200
55	El.Machry.	BRKT	1200

230 V.D.C. MOTORS

H.P.	Make	Type	Speed
400	A-C		415
200	West.	SK210	575
150	G.E.	MPC	400
125	G.E.	RC-15	1750
100	Al.Ch.		1150
90/45	G.E.	RF-17	950/475
75	Sprague		1000/1500
75	G.E.	RC36	800
75	West. (2)	SK-180	475
75	Cr.Wh.	LT	480/670
75	Cr.Wh.	CMC	375/960
75	E-D	25S	450/1350
75	West. (3)	SK151	250/1000
60	West. (3)	SK-160	680
50	G.E.	RC-12	1750
45/90	G.E.	RF-17	475/1950
50	West. (3)	SK-160	565
50	G.E.	RF-17	250/1000
50	West.	SK	250/1000
40	West.	SK-103	1750
40	Century	DN-454	1740
40	G.E.	RC-31	1700
40	G.E.	RC-32	1100
40	G.E.	RC-34	750
40	G.E. (2)	CD-1441	400/1500
40	Cr.Wh.	CCM	700
40	Rel.	461T	400/1200
35	West.	SK	250/1000
35	West.	SK-120	1150
35	G.E.	RLC	440/800
30	G.E. (3)	CDM-35	2200
30	West.	SK	975
30	Cont.	D-103	850
30	G.E.	RC-33	575
30	West.	SA	500/1500
30	West. (2)	SK-143	575
25	G.E.	RC-15	1750
25	West.	SK-88	1750
25	Rel.	9T	1150
25	West.	SA	500/1500
25	West. (2)	SK-130	600
25	G.E.	RF-14	800/1200

115 V.D.C. MOTORS

H.P.	Make	Type	Speed
300	West.	SK	900
100	Cr.Wh.	CMC	900
100	Cr.Wh.	CFC	1150
40	G.E.	CD-113	850
30	West.	S	600
25	G.E. (2)	CD	1800
25	West.	SK-103	1150
25	Cr.Wh.	CCM	750
25	West.	SA	600/1200
15	E.D.	7½S	650/1250
15	Cr.Wh.	CM	650
10	Al.Ch.		900
10	E.D.	7½S	425/1700

550 V.D.C. MOTORS

H.P.	Make	Type	Speed
765	G.E. (4)	MPC	1045/1350

AC GENERATORS

KW	Make	Type	Speed
180	G.E.	ATB	900
100	G.E.	ATB	360
50	F-M	GG	1200
15	G.E.	ASI	1200

AC GENERATORS
Driven by DC Motors

KVA	Make	D. C. Input	A. C. Output
62½	G.E.	230	240
50	Star	115	120
35	G.E.	230	220
31	Ideal	115	440
31	El. Machry.	230	440
18	G.E. (3)	230	120/240
10	Burke	115	120
7½	Hartner	115	440
6¼	G.E.	230	240
5	El.Spec.	115	110
1¼	Al. Ch.	230	110

600 V.D.C. GENERATORS

KW	Make	Speed
400	G. E. (4)	1200
325	G. E.	1200
30	Burke	1750
20	Reliance	1150

600 V.D.C. BALANCER

200 KW, G.E., MPC, 1200 RPM

GENERATORS
250 V.D.C. Motor Driven

KW	Make	Speed
1000	G. E.	900
500	West.	1200
300	Elliott	1200
250	G. E.	1150
200	G. E.	1200
200	West. Roto-trol	1200
150	West.	900
100	Delco	1200
90	G. E.	600
100	G. E.	700
75	G. E.	1200
50	A. C.	1200
40	Rel.	1750
42	ABC (2)	1200
30	G. E.	1200
25	G. E.	1200

125 V.D.C. Motor Driven

KW	Make	Speed
150	West.	1150
100	West. (2)	900
100	G. E.	1200
100	El. Machry.	1200
50	West. (2)	1150
30	G. E.	1150
30	L. A.	1450
25	El. Machry.	1150

GENERATORS
Low Voltage D.C.

Amp.	Make	Voltage
125	Hobart (8)	7½
1500	Century	24
2000	G. E.	24V
100	G. E.	80
1000	G. E.	33
150	Watton	40
1000 (2)	Chandeysson	40
250	G. E.	42
1500	G. E.	50
1500	Century	60
1500	G. E.	60
1000	G. E.	75

FREQUENCY CHANGERS AND GENERATORS

Size	Make	Output Frequency
180 KW	G. E.	180 cy.
154 KVA	G. E.	150 cy.
60 KW	G. E.	120 cy.
40 KW	G. E.	100 cy.
30 KW	G. E.	90 cy.
15 KW	G. E.	400 cy.
10 KW	G. E.	200/700 cy.
7½ KW	G. E.	400 cy.
3 KW	G. E.	400 cy.

TRANSFORMERS

2—400 KVA Maloney Dry Auto—220 to 440 V. 3 ph.
1—300 KVA, Al. Ch. 3 ph. 4160V/230 V.
1—300 KVA. Pittsburgh, 3 ph. 4160V/230V Secondary.
60—Additional Oil and Insulated Dry-type Transformers in stock, not listed, down to 1 KVA.

STARTERS—A. C.

1—450 H.P. West. magnetic reduced voltage (550 V.) Synch.
1—250 H.P. C-H Bulletin No. 9589 4160V.
1—200 H.P. G.E. CR-7065, 440V.
3—150 H.P. G.E. CR-7061, 220V.
2—100 H.P. C-H 220 V. Synch.
40—C-H and A-B; 2 and 4 speed.

STARTERS—D. C.

1—600 H.P. 230V. West. magnetic.
150—New 230V. D.C. magnetic starters, from 5 H.P. to 75 H.P., C-H, G.E., etc.
40—New 7½ H.P. 230V. magnetic reversing.
1—300 H.P. West. 115V. magnetic.

TRAVELING CRANES

2 Ton Harnischfeger, 26' 8¼" Span

Partial List ONLY

EST. 1910 — L. J. LAND INC. — 41st YEAR

156 GRAND STREET — Phone CAnal 6-6976 — NEW YORK 13, N. Y.

THE HOME OF VALUE AND QUALITY FOR . . .

ELECTRICAL POWER EQUIPMENT

GET A-1 PERFORMANCE
SAVE ON PRICE

HERE'S A WIDE SELECTION FROM OUR GIANT STOCK

SQUIRREL CAGE MOTORS
3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or higher)

H.P.	Make	Type	Speed
1000	*G.E.	K6347S	1800
750	*G.E.	KT	720
600	*A.C. (New)	AZ	3600
500	*G.E.	PBG	1800
500	*Fr.-Morse	HS	1200
450	*G.E.	KF-5678	1200
400	*Cent. (New)	NZ	1800
400	*Al-Ch.	ARWW	900
300	*Westgh.	CS	3600
300	G.E.	IE	1200
300	Al-Ch.	AR	900
300	Westgh.	CS	514
250	West. (New)	CS	1800
250	Al-Ch.(New)	ARW	900
250	L-Allis	146B	720
250	Westgh.	CS	600
150	G.E.	KT	1800
150	G.E.	IE	1800
150	*Al-Ch.(New)	ARW	1800
150	G.E.	IE	1200
150	Westgh	CS950A	800
125	West. (New)	CS504	3600
125	*Al.-Ch.	AR226	1800
125	G.E.(TEFC)	4K5208	1200
125	Westgh.	CS	900
125	G.E. (New)	K6333	900
100	Al-Ch.(New)	ARWWT	3600
100	*G.E.	FT542Z	1800
100	G.E.	FTRP	1800
100	*Westgh.	CS	1800
100	U.S. (Vert.)	CFU	1200
100	Burke	EW	1200
100	Westgh.	CB	1200
100	Cent. (New)	SC-585	900
100	G.E. (New)	K6333	720
75	Westgh.	CS701	1800
75	West. (New)	CS505S	1800
75	G.E.	K505	1200
75	G.E.	KT348	1200
75	*West.(Vert.)	CS	900
75	Ideal	AA350	720
75	*G.E.	IK	720
75	G.E.	FT-550	720
75	Triumph	TR10	514
60	West.(Vert.)	CSW445	1800
60	G.E. (New)	K5BU	1200
60	Al-Ch.(New)	AR8230	900
60	Al-Ch.	AR826F	514
50	G.E.	KT527	1800
50	U.S. (Vert.)	SCV	1800
50	Westgh.	CS640	1800
50	Westgh.	CS504	1200
50	G.E.	KT343	1200
50	*G.E.	KT342	900

Hundreds of Smaller Motors!

SLIP RING MOTORS
3 Phase, 60 Cycle, 220 or 440 volts (*2200 volts or higher)

H.P.	Make	Type	Speed
2000	*G.E.	MT30	240
1200	*Cr.-Wh.		240
800	*Al.-Ch.	3 Brg.	450
650	Westgh.	HE	350
500	Westgh.	CW	350
300	*G.E.	IM	1800
300	G.E.	MT	450
200	G.E.	IM	1800
150	West. (New)	CW772C	1200
125	G.E. (New)	M6333	900
125	G.E. (New)	M6334	720
100	G.E.	MT	1800
100	Al-Ch.	ANY	900
100	G.E.	IM	720
100	Westgh.	CW	800
100	G.E.	IM	450
75	Star	OSOO	900
60	G.E. (New)	M505	1200
60	Westgh.	CW	900
50	G.E.	IM	1800
50	Al.-Ch.	ARY	1800
50	Westgh.	CW	1200
50	G.E.	MT	720
50	G.E.	IM	420
40	G.E.	MT338	1200
40	Westgh.	CW-544	900
40	G.E. (New)	M5042	800
40	Al-Ch.	ARY223	720
35	F-M (Vert.)	UAB	1800
35	G.E.	IM	1200
30	Westgh.	CW	1800
30	Westgh.	CW445	900
25	G.E.	IM	1200
25	Al-Ch.	ARY-220	1200
20	Al.-Ch.	ARY-216	1200
20	G.E.	MT312	1200
20	G.E.	MT322	900
20	G.E.	IM	720
20	Westgh.	CW-644	900
15	L-Allis	GN320	1800
15	G.E.	IM	1800
15	Al-Ch.	ARY216	900
15	Ideal	AVE	900
10	Westgh.	CW324	1800
10	Westgh.	CW328	1200
10	Westgh.	CW365	900

SLIP RING MOTORS
Crane and Hoist Type 3/60/220 or 440 volt

H.P.	Make	Type	Speed
75	Westgh.	CI725BA	600
37	G.E.	HITC TENV	600
30	G.E.	ITC5010	1200
25	Westgh.	CI572	900
20	Westgh.	CI	900
15	G.E.	ITC5010 25Cy.	720
11	Westgh.	CI454	900
6½	R & M	425A TENV	1200
3	G.E.	MR254 TENV	1200

TURBINE SPECIAL
512 KVA Crocker - Wheeler AC Generator, 3/60/240/480 volt, d/c to
375 HP Worthington - Moore Turbine, Single Automatic, Non-Condensing, 425# PSI, 104° Exh., 180° F SH with Reduction Gear and Accessories

AC SYNCHRONOUS MOTORS
3 phase, 60 cycle, 220 or 440 volts (*2200 volts or higher)

H.P.	Make	Type	P.F.	Speed
800	G.E.	TS984	1.0	1800
750	*Westgh.		.8	900
700	G.E.	TS		514
320	*Al-Ch.	Dr Pf	1.0	720
300	Cr-Wh.	Eng.	1.0	300
250	*Al-Ch.	Dr Pf	.8	720
200	El. Mashy.	Ped	1.0	450
150	El. Mashy.	EM	.8	720
150	*Westgh.		1.0	300
125	*El. Mashy.	Syn	1.0	900
125	Cr-Wh.	103-S	1.0	900
125	*G.E.	TS	1.0	277
115	E.-M.	EM	1.0	240
100	Cr-Wh.	100S	.8	900
100	*G.E.	ATB	.8	900
100	Ideal	SMS	1.0	900
75	G.E.	ATI	1.0	900
60	G.E.	TS7538	1.0	1200
40	G.E.	ATB	.8	1200
20	Fynn W.	ISVRN		1200
15	Century	ARC350S	1.0	1200
4	G.E.	AK (25 Cy.)		1500

AC SYNCHRONOUS GENERATORS
3 phase, 60 cycle, 220 or 440 volts (*2200 volts or higher)

KVA	Make	Type	P.F.	Speed
1500	G.E.	ATI	.8	900
1000	*Westgh.	603D	.8	900
250	*Al-Ch. (New)		.8	720
150	El. Mach.	EM	.8	720
112.5	*G.E.	ATB	.8	1200
110	Cr.-Wh.	103	.8	900
100	*G.E.	ATB	.8	900
80	Fr.-Morse	S	.8	900
85	G.E.	ATB	.8	1200
50	G.E.	ATB	.8	1200
50	Cr.-Wh.	50BS	.8	1200
50	Westgh.		.8	1200
37.5	Al-Ch.	EA121	.8	1800

TRANSFORMERS
4—2500 KVA Westinghouse, 1 Ph., 60,000 V. Primary, 13,800 V. Secondary
1—750 KVA Westinghouse—AIR, 3 Ph. 12,500 V. Primary, 480 volts Secondary
1—750 KVA Westinghouse—Air, 3 Ph. 13,800 V. Primary, 2,300 V. Secondary
3—500 KVA General Electric, 3 Ph. 13,800 V. Primary, 240/480 V. Secondary
3—300 KVA General Electric, 3 Ph. 2400 V. Primary, 240/480 V. Secondary
3—250 KVA General Electric, 1 phase 2400/4160 volts Primary. 240/480 volts Secondary
6—167 KVA General Electric, 1 Ph. 2300/4160 V. Primary, 240/480 V. Secondary
3—150 KVA General Electric, 1 Ph. 13,800 V. Primary, 240/480 volts Secondary

MOTOR GENERATOR SETS

K.W.	Make	A.C.	D.C.
500	Westgh.	2300	250
500	Westgh.	550	250
500	Cr-Wh.	220/440	250
450	G.E. (3 Unit)	2300	125/250
400	Westgh.	2300	600
250	Westgh.-G.E.	440	250
200	Cr-Wh.	440	250
200	Ridgeway	2200	250
150	G.E.	2300/440	250
150	G.E.	440	250/275
150	Cr-Wh.	440	250
150	Al-Ch.	220	125
100	G.E.	440	250
100	G.E.	220	250
100	G.E. Delta	440	120/240
75	Al-Ch.	2300	110
75	Westgh.	2300	110
60	Al-Ch.	2300	110
40	Cr-Wh.	220	125
40	Elec. P—G.E.	440	250
40	Al-Ch.	440	250
30	Cr-Wh.	220	125
25	G.E.	440	250
20	G.E.	440	250
20	G.E.	440	125
10	Cr-Wh.	220	125
10	G.E.	440	250

D.C. TO A.C.

100	G.E.	230	250

BALANCING SETS
4—34 KW, 250 V., 270 A. Neut. Degen. Type MG1, 125 V. Gen. B3 Comp'd. on Fab. Base, d/c.
3—20 KW, 250 V., 160 A., Neut. Crocker-Wheeler, Type 151, 125 V. Gen. 3 Sl. Bearings, close-coupled.

AIR COMPRESSORS

Size	M	Make	Type	Displ.	Press
10	x10	Ing. R.	ERI	223	120
10	x8	Ing. R.	DRI	179	85
9	x9	Worth.	HB	211	100
9	x8	Ing. R.	ERI	145	100
8½	x8	Worth.	HB	179	100
7	x7	Worth.	HB	122	100

DIRECT CURRENT MOTORS 230 VOLTS

H.P.	Make	Type	Speed
375	Westgh.	Ped	650
200	Westgh.	SK210	900
175	Reliance	1400T	675
175	G.E.	ELC11	750
100	G.E.	RC34	2500
100	Westgh.	SK173	850
100	Al-Ch.	E152	575
40	Cr-Wh.	CMC	1750
40	G.E.	CD2004	600
35	Cr-Wh.	CM351	700
35	G.E.	C	600
30	Westgh.	SK129	975
30	Cr-Wh.	CCM	450
30	Westgh.	SK93	1750
30	G.E.	RC31B	1150
25	Westgh.	SK100L	1100
25	Westgh.	59	800
25	Al-Ch.	E-130	700
20	Westgh.	SK83	1750
20	G.E.	RC	1150
20	G.E.	LC	575
20	G.E.	RC	800

CHANDEYSSON Anodizer
NEW 1000 AMP. 40 volt, type NPT, d/c 60 H.P. Chas. A-28 Syn. Motor 3/60/220, 600 RPM, 25 deg. cont.

ROTARY CONVERTER
1000 KW Westinghouse, 600 RPM, 600 V DC, 4700/4200 V AC, 8 HP, 60 cy. with complete starting equipment

HI-PRESSURE PUMPS

GPM	Make	Type	Head
800	Worth.	6D8	825 Ft.
500	Manistee	H	250 Ft.
306	Al-Ch.	NMZ	800 Ft.

CHICAGO ELECTRIC CARRIES COMPLETE STOCKS OF:
- A.C. MOTORS • HOISTS
- D.C. MOTORS
- CONTROLS • M.G. SETS
- GENERATORS
- TRANSFORMERS
- COMPRESSORS
- PUMPS • SWITCHBOARDS

CALL CANAL 6-2900

First Source for 41 Years for Quality Electrical Equipment

CHICAGO *Electric Co.*

1320 W. CERMAK ROAD CHICAGO 8, ILL.

3—20 HP, Allis-Chalmers Electrifugal, Size 6L 220 or 440/3/60, 1750 RPM SP.PR. Cap. 1000 GPM 68' Head.
7—Ingersoll-Rand, Size 5 x 4, 500 GPM, 150' Head 3500 RPM with base and coupling for Frame 365-S Motor.
8—Morris Slurry Pumps, Size 1½, Mg. St., Imp. & Plates.
1—Milton Roy Chemical Proportioning Pump, 3" x 4" const. of Worthite with Hastelloy Valves, complete with 2 HP Master G.H. Motor.
1—5 HP, 5' Setting, Vertical Sump Pump, Size 2".
1—Beach-Russ, Vacuum Pump, 120 CFM, 15 HP V-Belt Drive.
1—Talor 4" Rotary Bronze Fitted, V-Belt Drive.

Motors—Air Compressors, Speed Reducers, and Vacuum Pumps. We solicit your inquiries and offerings.

C-B EQUIPMENT AND PUMP CO.
1440 N. B'way, St. Louis, Missouri
CE. 7976 CH. 1101

USED
HYDRO-ELECTRIC UNITS

3—500 KW 2300 Volt for 16-20' head
1—400 KW 2300 Volt for 26-30' head
2—250 KW 2300 Volt for 17-22' head
1—240 KW 2300 Volt for 200-250' head
1—200 KW 2300 Volt for 15-20' head
1—144 KW 480 Volt for 10-12' head
2—120 KW 2300 Volt for 10-12' head
2—15" Leffel Scroll turbines for 150-250' head
1—400 KW alternator 2300 volt 180 RPM horizontal

Many others. All subject to prior sale

WM. C. MOULTON ASSOCIATES
MONSON, MASS.

WESTINGHOUSE TYPE HQS PHASE SELECTOR RELAYS

For Selective-Pole Carrier Relaying. *Brand New, Complete.* Original cost $650.00 per set. Only 40 sets in stock. Circular available.

$95.00 each

ELECTRO SALES CO., INC.
108-110 Pearl St., Boston 10, Mass.

BOILER (A-1 Condition)
484 HP. 250 lbs. pressure, 100°SH.
Straight tube, cross drum, new 1930
STEPHEN A. DOUGLASS CO.
630 Fort Washington Ave., N. Y. 33, N. Y.

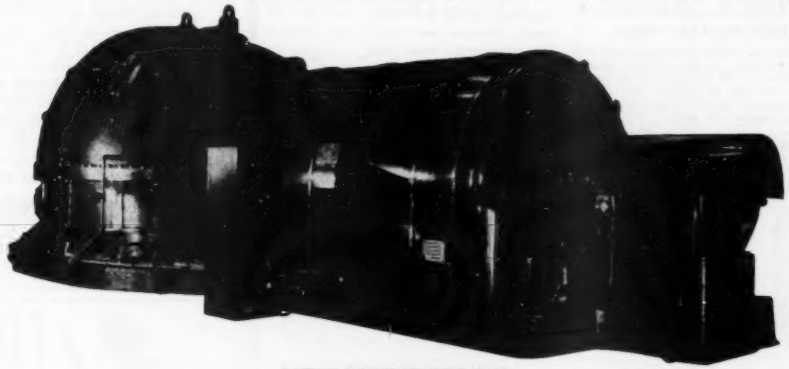
FOR SALE

495 New Star Electric Co., BALL BEARING, 230 Volts, D. C. Motors. 14½ H.P. Type SO-1520. 1290 RPM. Continuous Duty. F.L. 52 AMPS. Compound Wound. AMB—40°.

Typical Serial #4B 49-354

Eastern Scrap & Salvage Corp.
65 Mulrhold Avenue
Trenton, New Jersey
Telephone 5-6349

25,000 KVA—20,000 KW, 80% P.F., 3 phase 60 cycle, 13,200 volts, 1800 RPM General Electric Company condensing turbine generator unit 215 P.S.I.G. 540-550° total temperature complete with direct connected shaft exciter, switchboard and instruments, a 30,000 square foot 2-pass Westinghouse surface condenser, motor driven and turbine driven pumps and condensing accessories.



ACTUAL PHOTOGRAPHIC VIEW

EXCELLENT CONDITION — COMPLETE INSTALLATION — PROMPT DELIVERY

TURBINE-GENERATOR UNITS

3 phase, 60 cycle

6250 KVA G.E. condens., 3-stage, 2300/4000 volts, 200# P.S.I., 600°TT.

2500 KVA Westinghouse condensing 2300 volts.

2500 KVA G.E. Type ATB, Form HT, 2300/480 volts, 3600 RPM, two bearing alternating current generator LESS TURBINE.

2500 KVA G.E. condensing 200 P.S.I. 2400/600/480 volts.

1875 KVA Westinghouse condensing, 2300 volts, 250# PSI.

937 KVA G.E. bleeder condensing 215 P.S.I.G., 15# extraction, 2300 volts.

750 KVA Allis condensing, 150 PSI, 480 volts.

625 KVA G.E. non-condensing 150 P.S.I., 20# back, 480 volt.

125 KVA G.E. non-condensing, 150-200 P.S.I., 2300 volts.

125 KVA Westghse. non-condensing 150/250 P.S.I. 2400 volts NEW

Direct Current

300 KW Westghse. 3-wire, 250 volt 150/250# P.S.I. non-condensing

150 KW (2) Westinghouse-Worthington, 250 volts, 3-wire, 225-250 P.S.I. condensing.

100 KW (2) G.E. 125 volt, 200/275 P.S.I. non-condensing

75 KW (2) Westinghouse-Moore, 120 volt, 200# P.S.I. condensing.

60 KW (3) new Westinghouse, 120 volt, 200# P.S.I. condensing.

MOTOR GENERATOR SETS

100 KVA Westghse. 60 cycle, 2400 volts, 900 RPM alternator direct connected 135 HP, 220 volt direct current motor.

62½ KVA G.E., 60 cycle, 2300 volt alternator to 75 HP, 125 volt DC motor.

10 KW G.E. 125 volts direct current direct connected to 12 HP 60 cycle, 220 volt motor.

MAY BARGAINS
SPECIALLY PRICED

1—4400 sq. ft. Worthington surface condenser.

3—10,000 GPM 24" suction 20" dis. Cent. pumps each direct connected motor.

1—10,000 GPM 24" suction cent. pump direct connected motor.

1—10,000 GPM 24" suction cent. pump direct connected G.E. non-condens. turbine.

1—5425 GPM, 70 foot head Centrifugal pump connected 125 HP 60 cycle, 2200 volt, 1750 RPM G.E. motor.

2—1000 GPM, 1270 foot head, 4-stage Morris pumps each connected 417 HP, 390# P.S.I. non-cond. G.E. turbine.

1—G.E. Bank of Scott connected 2 to 3 phase, 60 cycle transformers, 2500 KVA capacity.

1—20 KW 125 volt direct current generator connected Hill Diesel engine.

UNAFLOW GENERATOR UNITS

Alternating Current—3 phase, 60 cycle

750 KVA G.E. 2300/440 volt generator direct connected Skinner non-condensing engine.

500 KVA G.E., 2400/480/240 volts generator connected Ames Vertical Engine, 150#.

375 KVA G.E., 2300/440 volts generator connected 23"x24" Skinner Horizontal Engine.

175 KVA Westghse., 240 volt generator connected Skinner Horizontal Engine, 125-150# P.S.I., 5# gauge back.

Direct Current

400 KW G.E. 250 volts, 360 RPM generator connected Skinner vertical engine 150#.

275 KW Westinghouse, 250 volt generator connected Ames vertical engines, 150#.

250 KW Crocker Wheeler 125 volt generator direct connected Ames Vertical Unaflow non-condensing engine 150#.

250 KW (2) G.E., 3-wire, 250 volts generators connected Skinner engines, 150#.

15 KW, 120 volt generator connected Troy Engberg engine 125#.

SYNCHRONOUS MOTORS

5000 KVA Westinghouse, 4000 volt, 720 RPM Electrical Synchronous (condenser).

900 HP Allis, 2200 volts, 150 RPM.

300 HP G.E., 80% P.F., 2300 volts, 720 RPM.

DIESEL GENERATING PLANTS

1150 KW Capacity complete installation consisting of 1—700 KW and 1—450 KW, 3 phase 60 cycle, 480 volt generators each direct connected to a Worthington Diesel engine with all appurtenances.

3—187 KVA, 3 phase 60 cycle, 240 volts, 400 RPM generators direct connected to 225 HP, 6 cylinders Buckeye Diesel Engines.

UMC UTILITIES MACHINERY CORP.
1965 EAST 6th STREET • CLEVELAND 14, OHIO • Long Distance 422

ELECTRICAL EQUIPMENT — REBUILT and GUARANTEED

MOTORS—GENERATORS—MG SETS—TRANSFORMERS—CONTROLS

PROMPT SHIPMENT — PARTIAL LISTING

VARIABLE VOLTAGE DRIVE

40 H.P., Variable Voltage Drive consisting of:
1—40 KW, 230 Volts, Induction M-G Set, with two auxiliary 5 KW generators and exciter.
1—40 H.P., 230 Volt, DC Motor.
With full magnetic control providing jog forward, jog reverse, run, stop.

SLIP RING MOTORS—3 Ph., 60 Cy.

Qn.	HP	Speed	Volts	Make	Type
6	7½	810	550	G.E.	MTC-5301
2	10	1140	410	West.	HF-7A
2	10	570	220	G.E.	HI-11
2	11‡	820	550	G.E.	ITC-5008
2	15	1160	440	West.	CW-464C
2	15	570	220	West.	CW-646
1	18	680	440	West.	MW-316
1	20	860	440	West.	CW-638
1	25	1130	550	G.E.	MT-323
2	25	350	220	Wagner	BR
2	25	720	440	Wagner	22VBR
1	30	865	440	West.	CW-646
1	30	350	440	G.E.	MT-332
1	30	675	440	G.E.	MT-336
2	35	600	400	F-M	HV-H16A
2	40	885	2200	Al.Ch.	ARV-223C
1	40	560	440	G.E.	MT-346
1	50	1150	440	G.E.	M-5326
1	50	860	440	West.	HF-12A
1	50	570	440	G.E.	MT-352
1	52‡	550	220	G.E.	IQC-5013***
1	60	685	440	West.	CW-758
1	60	570	550	G.E.	MTC-5546
1	60	345	550	West.	CW-938
1	80‡	575	440	G.E.	MTC-5352
2	125	430	440	G.E.	IL-16
2	150	1750	440	G.E.	MTP-549
1	175	500	550	West.	CW-1002
1	200	495	2200	G.E.	IM-17A
1	250	600	2300†	G.E.	IM-17
1	300	900	440	G.E.	IM-17
2	300	880	2200	G.E.	IM-17A
4	350	1775	2300	G.E.	IM-E15A
2	350	880	2200	G.E.	IM-17A
1	400	565	550	West.	CW
1	600	1770	440	G.E.	IM-E15C
1	650**	360	440	G.E.	MT-442Y
1	700	734	4000‡‡	West.	CW

220 volt motors can be reconnected for 440 volts. ‡Intermittent rating. ***2 phase. **New. ‡‡25 cycle.
†Also 440 or 550 volts. *Also 440 or 2300 volts.

A.C. GENERATORS — NEW

3 Phase, 60 Cycle, 0.8 P.F., Two Bearing, with Damper Winding & Direct Connected Exciter.

Qn	KVA	RPM	Make	Volts
4	18.7	1800	Columbia	240/120
4	18.7	1800	Columbia	208/120

230 VOLT CONST. SPEED D.C. MOTORS

Qn.	HP	Speed	Make	Type
10	3	850	Reliance	Y-23T
25	3½	850	West.	SK-30
1	7½	1150	G.E.	CDM-46
3	7½	850	G.E.	CD-75
10	*9**	1750	Kimble	BA-324
4	10**	1150	Al.Ch.	EB-80
2	10	850	West.	SK-83
10	13½**	600	West.	SK-93
3	15	1750	G.E.	CD-75
5	15	825	West.	SK-90
1	20	1750	L.A.	ONA-L851
1	20**	1150	G.E.	CDM-83
1	20	1750/1310	West.	SK-83
2	20	1150	G.E.	RC-30
1	20**	1450	G.E.	CDM-35
11	25	750	West.	SK-110L
17	25	825	West.	SK-120
1	30	1100	G.E.	RC-12
1	40	1700	West.	SK-103
1	40	750	G.E.	RC-34
1	50	750	West.	SK-150
1	50	650	G.E.	RC-16
1	60	1750/1310	West.	SK-143
1	150	700	Al.Ch.	
2	200	1150	G.E.	RC-38
1	250	1150	C.W.	CMC-101A

230 VOLT ADJ. SPEED D. C. MOTORS

Qn.	HP	Speed	Make	Type
6	5/7½	600/1800	G.E.	RA-30
1	10	400/1600	Reliance	T-92T
1	12½	230/940	West.	SK-130
10	12½**	600	West.	SK-93
1	15	600/1200	West.	SK-100L
1	20	500/1500	G.E.	RF-11
1	20/25	100/1200	West.	SK-153
1	25	400/1600	G.E.	RF-13
1	25	500/1500	G.E.	RF-12
1	25/29	500/1200	G.E.	RF-13
1	30	400/1200	West.	SK-163
1	30/40**	400/1600	G.E.	CD-1236
1	35	500/1500	West.	SK-143
1	40/50	400/1200	Reliance	T-4611
1	75	500/1500	Cr.Wh.	CCM
1	75	375/750	Cr.Wh.	
2	100	225/900	G.E.	MPC-125M
8	100	400/1200	Al.Ch.	
1	100	320/960	West.	SK-200
1	125	450/1000	West.	SK-190
1	175	230/500	West.	SK-220
2	375	350/500	G.E.	MPC

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy.
Totally Enclosed Fan Cooled, Ball Bearing

Qn.	HP	RPM	Volts	Make	Type
2	⅝	1750	440	L.A.	JA-254
10	⅝	1730	440	G.E.	K-254
5	7.5	1740	440	G.E.	K-284
1	10	1735	440	West.	CS-324
1	10	1140	440	Wagner	CP2-326
1	15	1745	440	West.	CS-326
1	15	1175	440	L.A.	JA-365
1	20	1760	220	G.E.	K-364
1	25	1760	220	G.E.	K-365
1	25	1200	550	G.E.	K-405
1	25	1170	220	L.A.	JX-405
1	25	705	440	West.	CS-W504
1	40	3565	440	G.E.	KF-4058

SPLASHPROOF, BALL BEARING

Qn.	HP	RPM	Volts	Make	Type
23	⅝	1750	440	L.A.	FB-254
1	⅝	1735	220	G.E.	K-254
1	⅝	1160	440	L.A.	FX-344
1	15	1175	440	L.A.	JA-365
4	15	1150	440	L.A.	FX-365
2	40	1175	220	G.E.	K-445
7	50	1780	440	L.A.	FX-445A
8	50	1160	220	G.E.	K-504
1	150	1775	440	L.A.	FX-1168
3	150	880	440	L.A.	FX-1368
1	150	700	440	G.E.	KF-8335

OPEN TYPE MOTORS

Qn.	HP	Speed	Volts	Make	Type
1	15	3485	220	Reliance	AA-B3247
5	15**	1735	440	Century	SC326
1	15	1200	220	G.E.	KT-502
1	15	960	220	G.E.	FTR-512
1	20**	3475	220	West.	CS-326
5	20**	1750	440	Wagner	BPI-364
1	20	1750	220	West.	CS-W364
1	20	1200	220	G.E.	KF-512
2	20	1160	440	West.	CS-464C
2	20	900	220	G.E.	FTR-522
1	25	1800	220	G.E.	KT-312
5	25**	1740	440	Century	SC-364
1	25	1160	440	West.	CS-667C
1	25	900	220	Howell	8CRB-356***
1	25**	875	440	Master	PB-405
2	25	575	440	G.E.	KT-542
3	30	3550	550	G.E.	K-3648
1	30	1755	220	G.E.	FT-513
1	30	1160	440	West.	CS-644
1	30	870	220	West.	CS-646
1	40**	3545	220	G.E.	KF-4048
2	40	1750	440	West.	CS-583C
2	40	900	2300	G.E.	FTR-536
4	50**	1750	440	Wagner	BP5-405
1	50	850	220	West.	CCL
2	60*	1750	440	Ideal	AH-444
2	60	900	440	G.E.	KT-346
1	75	1160	440	West.	CS-662C
4	75	870	220	West.	CS-766A
2	75	865	2300	G.E.	KT-352
1	100	690	220	West.	C
1	100	580	2200	G.E.	IK-15A
2	100	500	2200	West.	CS-930
1	100	495	2200	Al.Ch.	AN
1	125	435	440	Al.Ch.	AR
2	125	400	2300	G.E.	I-17-FR
1	200	580	550‡‡	G.E.	KT-5668
2	200	587	2200	West.	CS-9[illegible]A
1	500	1200	140	G.E.	KTP-567
1	700	1800	2300/4000	West.	CS-4-39D-12

220 volt motors can be reconnected for 440 volts. **New. ***2 Phase. ‡‡Reconnectable for 440 volts.

G. E. DYNAMOMETER

Cradle Type, with control and Dial Scale. (Write for Complete Specifications.)

Qn.	HP	DC Volts	RPM	Type
1	200	250	1200	C

MOTOR GENERATOR SETS

125 and 250 Volts D. C.

(Write for complete Specifications)

KW	Make	RPM	DC Volts	AC Volts
2	Cont.	1750	125	220/440
7.5	West.	1455	125	380/220‡
10	West.	1750	125	220/440
10	West.	1450	125	220/440†
10	West.	1150	250	220/440
15**	G.E.	1800	125	220/440
15	G.E.	1755	250	220/440
15	West.	1450	125	220/440‡
16	West.	1750	125	2200/440
25	G.E.	1200	125	220/440
30	G.E.	1800	250	220/440
30	Al.Ch.	1750	125	220/440
50	G.E.	1720	125	220/240†
75	G.E.*	1200	125	220/240

Note: 3KW, 5KW & 7.5KW, 250V Sets Available. **New. *Synch. Motor Driven. ‡50 Cy. †25 Cy.

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention. All Equipment is Located in Our Cleveland Warehouse. We have Controls for Most Items Listed.

ELECTRIC GENERATOR & MOTOR CO.

4521 HAMILTON AVE. CLEVELAND 14, OHIO

JOHN H. BENSON ROY L. WILIMZIG

PUMPS!!

2—20"x16" Economy AA511, 12000 GPM, 75' Hd. 1200 RPM; 300 HP Motor and starters; NEW 1948.
2—Ditto, except 40' Hd. and 900 RPM.
2—10"x8" Morris Slurry Pumps, No. 85, 1000 GPM, 110 ft. head, 150 HP, 700 RPM, with or without motors.
1—Northern Hydraulic 3000 PSI, 99 GPM, Size 5820, 580 RPM, NEW SURPLUS.
1—4" GOULDS 500 GPM, 1320' Hd. 3500 RPM, Fig. 3360, 250 HP.

1000 OTHER PUMPS IN STOCK! PHONE, WRITE OR WIRE!

C & S MACHINERY CO.
1708 N. 8th St.
St. Louis 6, Mo.
GA-4290

FD&ID FANS

POWER EQUIPMENT

INDUCED DRAFT FAN—60700 CFM
American Blower Corp. Driven by Worthington Turbine with Gear.

FORCED DRAFT FAN—39000 CFM Green Fuel Economizer—Terry Turbine

BOTH USED LESS THAN 9 MONTHS

Write us for complete specifications.

MERRILL and COMPANY
407 S. Dearborn St., Chicago 5, Illinois
Telephone HArrison 7-8289

ELECTRIC BOILER

One Combustion Engineering Co., Electric Steam Generating Unit, A.S.M.E. Code, Kaolin Type, 500 HP, 250 PSI, 5000 KW, 2300 Volts, 3/60, consisting of Main Drum with 3 Electrodes, Large Code Accumulator, control panel, pump, safety, blowdown and feed valves, with piping as removed from service. Built in 1945, installed 1946 and used intermittently short time. Condition excellent. Offered at big saving and immediate stock delivery. *Write or phone for complete details.*

Sundfelt Equipment Company, Inc.
220 Hudson St. Seattle 8, Wash.

FOR SALE—IMMEDIATE SHIPMENT

5—700 HP BOILERS—250 #—Combustion Engineering VA.
3—500 HP BOILERS—300 #—Erie City 3 Drum 250 HP Laclede Stoker—Almost New—
TANKS 1½ million and 1 million capacity (gallons.)
Immediate Shipment of scarce materials—Turbines—Diesels. Send us your Inquiries—Also Surplus Lists.

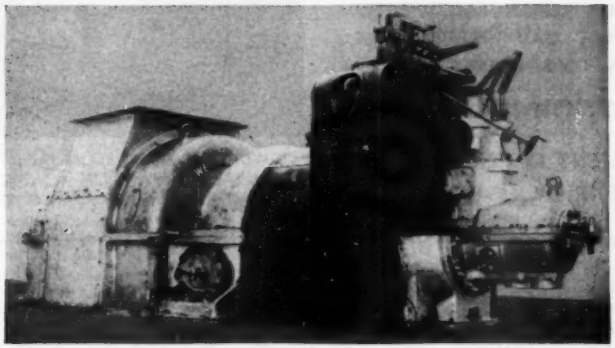
WE BUY AND SELL
H. A. WOODWORTH ENG. CO.
611 Olive St.—St. Louis (1) Main 1071

EXCELLENT POWER UNITS

2—125 KVA Westinghouse AC generators, 440 Volts, 277 RPM. Powered by 2 Bruce Mac Beth gas/gasoline engines.
1—150-HP, 225 RPM, Synchronous motor. Real Bargains.

A A A IRON CO.
Canton & Hawkins Sts., Dallas 1, Texas

OUR SPECIALTIES ARE
TURBO-GENERATORS, BOILERS, DIESEL POWER

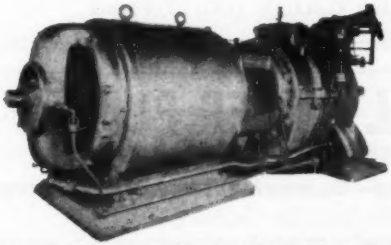


The Above 2500-KVA., Westinghouse Condensing Turbo-Generator is a Complete Unit, Ready for Installation. Steam Pressure 250-psig., 650° FTT. Voltage, 3/60/2300, 3600-RPM., 28"-Vacuum. Condenser, 2-pass, Surface Type, West. 3,000-sq. ft., Circulating, Condensate Pumps, Steam Jet Air Evactor. Complete Switchgear, Exciter, etc. Turbine Serial 12567: Generator, 4782722. Now in Storage. IMMEDIATE DELIVERY. Bulletin 600 is FREE on request.

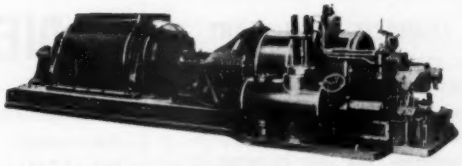
20,000-KW., .8% pf., 25,000-KVA., General Electric, Condensing
10,000-KW., .8% pf., 12,500-KVA., General Electric, Condensing
10,000-KW., .8% pf., 12,500-KVA., Allis-Chalmers, Condensing

BOILERS: SPECIAL

1—450#, 750° FTT., Combustion Engrg., 70,000# Steam per hour, and
1—B&W, 100,000# Steam per hr., 850#, 850°FTT.
BOTH COAL, GAS OR OIL FIRED. No. 1 Cond. IMMEDIATE DELIVERY.



A 750-KW., G.E., Condensing, Aut. Extr., 90% of Throttle Flow at 15#, 215# psig., 3/60/2300-v., 937-KVA., 3600-RPM. Condition, Pass any Inspection. Complete Unit, Condenser, Switchboard, Exciter. INVESTIGATE NOW. Turbine Serial, 28304: Generator, 3868840. Also 2-750, 480-Volt, Same as Above in Stock. Bulletin 975 with Specs., Illustrated Is Free.



Above Allis-Chalmers 1500-KW., .8% pf. Never used since U.S. Govt., spent $8000 rebuilding it, account changed their plans. Steam psig., 150/200#, .8% pf., 1875 KVA., Generator 3/60/2300-v., 3600-RPM. Good for 15 yrs. cont. service with no repairs. PRICED FOR QUICK SALE. Bulletin 500.

CORRESPONDENCE INVITED

TELEPHONE, WIRE OR WRITE.

CHARLES WEAVER, M.E.
OWNER
4145 PENOBSCOT BUILDING
DETROIT 26, MICHIGAN

TELEPHONES
WOODWARD 1-1340
WOODWARD 1-1341
WOODWARD 1-6038

OUR BEAUTIFUL BULLETINS (In Colors) Mailed on Request.
ALWAYS GET WEAVER'S PRICES
ARE BIG MONEY SAVERS.
We Own All Equipment We Offer.

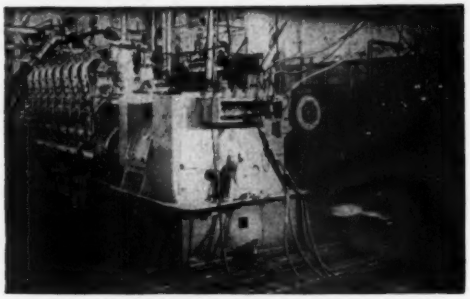
DIESEL POWER

AT 40% TO 60% SAVINGS

EACH ENGINE "REMANUFACTURED"
AND "FULL-LOAD TESTED"
PRIOR TO SHIPMENT

INSPECTION INVITED

ALL EQUIPMENT OFFERED WITH ONE YEAR GUARANTEE



VIEW OF ENGINE TEST STAND FACILITIES AT OUR PLANT IN SAUSALITO (S.F.) CALIF. ALL ENGINE TESTING CONFORMS TO DIESEL MANUFACTURERS' STANDARD METHODS.

A PARTIAL LIST OF OUR INVENTORY

KVA	MAKE	MODEL	HP	RPM	KVA	MAKE	MODEL	HP	RPM
1875	Fairbanks Morse	33E16	2000	300	312.5	General Motors	8-268A	450	1200
1420	Fairbanks Morse	38D	1600	720	312.5	Clark	GD-4	375	327
1250	General Motors	16-278A	1600	720	300	Fairbanks Morse	YVA	360	257
1000	General Motors	12-278A	1200	720	250	General Motors	8-268A	350	1200
937.5	General Motors	12-567	1080	720	237	Ingersoll-Rand	S	255	600
625	Alco	6-12½x13T	750	600	200	Buckeye	80	240	600
625	General Motors	8-567	720	720	156	Buckeye	E	190	400
425	Baldwin	VO	510	450	125	General Motors	3-268A	150	1200
400	Buckeye	80	480	600	75	General Motors	6-71	90	1200
375	Enterprise	DSG-6	450	450	62.5	Int'l Harvester	UD-18	76	1200
330	Superior	KNA	396	514	50	General Motors	4-71	60	1200

A. G. SCHOONMAKER COMPANY, INC.

52 CHURCH STREET, NEW YORK 7, N. Y.

SHOPS AND WAREHOUSE: JERSEY CITY, N. J. AND SAUSALITO (S.F.) CALIFORNIA

COMPLETE DIESEL PLANT

3—575 HP F.M. 5 cylinder, 400 RPM. 383 KW F.M. 3/60/2300 alternators. Woodward governors, heat exchangers and complete plant auxiliaries. For sale in whole or part. Condition excellent.

MISSISSIPPI VALLEY EQUIPMENT CO.
507 Locust St. St. Louis 1, Mo.

BOILERS

10 to 5000 H.P.
Diesel Steam Turbine Engine

GENERATORS

Heavy Power Equipment
Industrial — Chemical Process Equipment

UNUSED — RECONDITIONED

DEAN G. STRICKLER & ASSOCIATES
1346 Connecticut Avenue, N.W.
Washington 6, D. C. • DuPont 3384

DIESEL POWER PLANTS

50 KW TO 1250 KW

Remanufactured—Guaranteed! Immediate Delivery!

GM 8-268A Propulsion Engine with reduction gear
GM 3-268A 100 KW AC or DC with Switchboard
GM 8-268A 200 KW AC with Switchboard
GM 12-567A 900 H. P. Marine Propulsion Complete with accessories
GM 16-278A 1600 H. P. Marine Propulsion
Superior GDB-8 150 H. P. 100 KW D.C. 3 wire with or without Generator

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STEAM TURBINE GENERATOR UNITS

3 Phase 60 Cycle

25,000 KVA General Electric condensing, 200 lbs. steam pressure, 530° FTT, 13,200 volts, with surface condenser.

21,500 KVA General Electric condensing, 200 lbs. steam pressure, 550° FTT, 2400 volts, with surface condenser.

12,500 KVA General Electric condensing, 200 lbs. steam pressure, 550° FFT, 2400 volts, with surface condenser.

12,500 KVA Allis-Chalmers condensing, 225 lbs. steam pressure, 550° FTT, 13,200 volts, with surface condenser.

7,500 KVA Westinghouse condensing, 200 lbs. steam pressure, 600° FTT, 2300 volts, with surface condenser.

6,250 KVA Allis-Chalmers condensing, 200 lbs. steam pressure, 500° FTT, 2300/4,000 volts, with surface condenser.

5,000 KVA Westinghouse condensing double extraction 400 lbs. steam pressure, 600° FTT, 125 lbs. and 20 lbs. extraction, 480 volts, with surface condenser.

2,500 KVA General Electric condensing extraction, 200 lbs. steam pressure, 550° FTT, 20 lbs. extraction, 480 volts, with surface condenser.

1,875 KVA Allis-Chalmers condensing, 150 lbs. steam pressure, 500° FTT, 2300 volts, with jet condenser.

1,250 KVA General Electric non-condensing, 150-250 lbs. steam pressure, 600° FTT, 0-50 lbs. exhaust, 2400 volts.

1,250 KVA Westinghouse condensing extraction, 150-250 lbs. steam pressure, 600° FTT, 5-25 lbs. extraction, 480 volts, with surface condenser.

625 KVA Westinghouse non-condensing, 150-200 lbs. steam pressure, 600° FTT, 5-25 lbs. exhaust, 480 volts.

STEAM ENGINE GENERATOR UNITS

3 Phase 60 Cycle

750 KVA Allis-Chalmers-Ames vertical uniflow, 150 lbs. steam pressure, 5 lbs. exhaust, 2400/4160 volts.

625 KVA General Electric-Skinner horizontal uniflow, 150 lbs. steam pressure, 5 lbs. exhaust, 240 volts.

500 KVA Allis-Chalmers-Chuse horizontal Corliss, 150 lbs. steam pressure, 10 lbs. exhaust, 480 volts.

375 KVA General Electric-Skinner horizontal uniflow, 150 lbs. steam pressure, 5 lbs. exhaust, 480 volts.

312 KVA Allis-Chalmers horizontal Corliss, 150 lbs. steam pressure, 10 lbs. exhaust, 2300 volts.

250 KVA General Electric-Ames vertical uniflow, 150 lbs. steam pressure, 5 lbs. exhaust, 480 volts.

240 KVA General Electric-Skinner horizontal uniflow, 100-150 lbs. steam pressure, 0-4 lbs. exhaust, 240 volts.

SPECIAL

NEW 2859 KVA VARIABLE FREQUENCY GENERATORS

240 Cycle

3—2000 KW 70% P.F. 2859 KVA New General Electric A.C. generators, 3 phase, 240 cycle, 4150 volts, type ATB-6, 4800 RPM. Can be operated at lower frequencies with proportionate reduced speeds.

DIESEL ENGINE GENERATOR UNITS

3 Phase 60 Cycle

1,675 KVA Fairbanks-Morse, 2400/600/480 volts, 300 RPM.

1,000 KVA Hamilton, 2300/4000 volts, 600 RPM.

900 KVA Fairbanks-Morse, 2400 volts, 257 RPM.

782 KVA Worthington, 480 volts, 327 RPM.

546 KVA Worthington, 480 volts, 327 RPM.

450 KVA Alco, 480 volts, 514 RPM.

312 KVA Worthington, 208 volts, 450 RPM.

SPECIAL

1675 KVA DIESEL ELECTRIC POWER PLANT

1675 KVA Fairbanks-Morse generator, 3 phase, 60 cycle, 2400 volts, 300 RPM, direct connected to

1750 HP Fairbanks-Morse diesel engine, 2 cycle, 10 cylinders, Model 33E16, 300 RPM.

Complete with direct connected exciter, switchgear, starting equipment, heat exchanger, air scavenger, pumps, oil reclaimer, Maxim silencer, and interconnecting piping and fittings as in operation.

New 1942—Excellent Condition.

SYNCHRONOUS MOTOR GENERATOR SETS

1,500 KW General Electric generator, 250 volts direct current, direct connected to 2100 HP General Electric Synchronous motor, 3 phase, 60 cycle, 2200 volts.

1,250 KW General Electric generator, 250 volts direct current, direct connected to 1750 HP General Electric Synchronous motor, 3 phase, 60 cycle, 2200 volts.

750 KW Allis-Chalmers generator, 250 volts direct current, direct connected to 1000 HP Allis-Chalmers Synchronous motor, 3 phase, 60 cycle, 2300 volts.

750 KW General Electric generator, 600 volts direct current, direct connected to 1000 HP General Electric Synchronous motor, 3 phase, 60 cycle, 2300 volts.

ROTARY CONVERTERS

3,500 KW General Electric rotary converters, 250 volts direct current; 3 phase, 60 cycle, 12,000 volts alternating current.

3,500 KW Westinghouse rotary converter, 250 volts direct current; 3 phase 60 cycle 12,000 volts alternating current.

STEAM BOILERS

720 HP (2) Combustion Engineering Water Tube Boilers, 60,000 lbs. steam per hour, 450 lbs. steam pressure, 600° FTT, with Coxe chain grate stokers.

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TURBINE UNITS

1—12500 KVA Allis Cond. 60 cy. 13800 V. 300-lb.
1—10000 KVA G. E. Cond. 25 cy. 6600 V. 200-lb.
1— 5000 KVA West. Extr. Cond. 60 cy. 480 V. 385-lb.
1— 3125 KVA G. E. Cond. 60 cy. 2300 V. 150-lb.
1— 2500 KVA Worthington Non-C. 60 cy. 2300 V. 150-200 lb. 40-lb. BP
1— 2500 KVA G. E. Cond. 60 cy. 2200 V. 125-150 lb.
1— 2500 KVA G.E. Extr. Cond. 60 cy. 480 V. 185-200 lb. steel valve chest.
2— 2250 KVA G. E. Cond. 60 cy. 240-480 lb.
1— 1250 KVA Allis Cond. 60 cy. 2300 V. 150-200-lb.
2— 1250 KVA Elliott Cond. 60 cy. 480 V. 150-200 lb. 600 Surface Condenser
1— 938 KVA G. E. Extr. Cond. 60 cy. 240 V. 200 lb.
1— 750 KVA G. E. Extr. Cond. 60 cy. 480 V. 200-lb.
1— 625 KVA West. Cond. 60 cy. 480 V. 150-lb.
2— 250 KVA Elliott Non-C. 60 cy. 208 V. 200-lb. 5-lb. BP
1— 75 KW West. Cond. 125/250 V. DC 400-lb.

DIESEL ENGINE UNITS

2—1400 HP Fair. Morse 2400 V. 60 cy.
1— 900 HP Amer. Loco. 250 V. DC
1— 650 HP Amer. Loco. 440 V. 60 cy.
2— 600 HP Amer. Loco. 250 V. DC
1— 600 HP Fair. Morse 2400 V. 60 cy.
1— 350 HP Buckeye 240 V. 60 cy.

STEAM ENGINE UNITS

1—312 KVA Skinner Uniflow 480 V.
1—250 KVA Ames Vertical Uniflow 480 V.
1—250 KVA Ames Uniflow 480 .
2—187 KVA Ames Vertical Uniflow 240/480 V.
1—156 KVA Ames Vertical Uniflow 240 V.

ROTARIES—60 CY.

QU.	KW	MFR.	VOLTS-DC	TRANS.	RPM
1	3250	G.E.	225/285	13800	300
1	2000	A.C.	600	4150	514
2	1000	West.	600	4150	720
3	1000	G.E.	600	13200	900 Auto.

MERCURY ARC RECTIFIERS

QU.	KW	KIND	DC VOLTS	TRANS.
2	4500	Multi Anode	600	13800
4	3250	Ignitron	650	33000
2	1850	Ignitron	380	23000
1	1000	Ignitron	600	13800

MOTOR GENERATOR SETS—60 CY.

QU.	KW	MFR.	VOLTS-D.C.	A.C.	RPM
1	1500	G.E.	250	2200	514
1	1250	G.E.	250	2200	720
1	1000	G.E.	600	13200	514
1	750	A.C.	275	440	720
1	750	A.C.	250	2300	514
1	500	West.	125	2300	720
1	400	G.E.	250	6600	720
1	75	Star	240	440	1200
1	75	West.	125	440	1200

SYNCHRONOUS CONDENSERS

QU.	KVA	MFR.	VOLTAGE	RPM
1	2500	G.E.	2400/4160	720
1	2000	West.	2300	720
1	1500	G.E.	4800	900
1	1500	West.	2300	900

SYNCHRONOUS MOTORS—60 CY.

QU.	HP	MFR.	VOLTAGE	RPM
1	4350	Cr. Wh.	13800	514
1	1000	E. M.	2400	720
2	700	West.	2300	200
1	600	G.E.	440	360
2	350	G.E.	2300	257
1	300	G.E.	2300	600
1	300	West.	2300	900

FREQUENCY CHANGERS

QU.	KVA	MFR.	CYCLES	RPM
1	3125	G.E.	25/60	300
1	3000	G.E.	60/25	300
2	2500	G.E.	25/62½	750
1	2450	G.E.	62½/25	750
1	1250	G.E.	25/60	300
1	1250	West.	25/60	300
2	1000	G.E.	25/60	300
1	500	A.C.	25/60	300

TRANSFORMERS—60 CY.

1— 7500 KVA G.E. 138000—41000, 3 ph.
3— 3333 KVA West. 132000—77620/13200 Y
1— 2800 KVA G.E. 88000—13800/23900, 3 ph.
3— 1000 KVA West. 66000—7200
3— 500 KVA G.E. 66000—2400
1— 2500 KVA G.E. 69/75 KV—5 taps, 3 ph.
4— 188 KVA Kuhl. 44000—7200/12470
3— 75 KVA G.E. 44000—2300/4000
3— 8333 KVA West. 43800—13800
4— 6667 KVA G.E. 38100/88400 Y—12700/22000 Y/13200
3— 100 KVA Wag. 36000—7200/12470 Y
1—18750 KVA A.E.B. 34840—11000, 3 ph.
2— 7500 KVA Al. Ch. 33000—13800, 3 ph.
6— 200 KVA G.E. 33000—2300/6900
3— 167 KVA G.E. 33000—2300/4000 Y
6— 150 KVA G.E. 34500—2300/4000
4— 150 KVA G.E. 33000—7200/12470
6— 75 KVA Wel. 33000/18500—2300/6900
3— 75 KVA Wag. 33000—7200/12470 Y
6— 50 KVA G.E. 33000—2300
1— 4500 KVA G.E. 27000—2300, 3 ph.
1— 7500 KVA G.E. 26400—612, Rectifier Type
3— 3750 KVA West. 25400/13200—2400
4— 450 KVA Al. Ch. 23410/44000—13280/23000
1— 3000 KVA G.E. 22000—480, 3 ph.
1— 2000 KVA G.E. 22000/11000—2300, 3 ph.
1— 1000 KVA G.E. 22000/11000—2300, 3 ph.
5— 833 KVA G.E. 22000—480
3— 333 KVA G.E. 22000/11000—2400
4— 750 KVA Wag. 19850/33000 Y—6900/11950
3— 750 KVA West. 13200—440
3— 333 KVA G.E. 13200—240/480
2— 200 KVA G.E. 11500—220/110
3— 1250 KVA Mel. 11000—2300
4— 833 KVA G.E. 7620/13200 Y—2300
1— 1500 KVA West. 4000—2300, 3 ph. Auto
3— 500 KVA G.E. 4000—2300
3— 200 KVA A.C. 2400—120/240
3— 100 KVA Kuhl. 550—220/110
12— 15 KVA Stand. 450/225—117/234

OIL CIRCUIT BREAKERS

4—600 A.	154 KV G.E.	FHKO-39-2500	Outdoor
1—600 A.	132 KV G.E.	FHKO-60-1500	Outdoor
2—600 A.	73 KV G.E.	FHKO-139-1000	Outdoor
1—400 A.	73 KV G.E.	FHKO-236-500	Outdoor
1—600 A.	37 KV G.E.	FHKO-139-450	Outdoor
2—400 A.	37 KV G.E.	FHKO-236-500	Outdoor
4—900 A.	15 KV G.E.	FHKO-139-750	Outdoor
2—600 A.	15 KV West.	B-28-B-500	Indoor

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Water Tube. Babcock & Wilcox, 1945. 2 Drum, Bent Tube, Economizers. Internal Desuperheater. Superheaters: W.P. 400 P.S.I. Hydrostatic Press. 718 P.S.I. Heating Surfaces: 2441 sq. ft. Superheater 350 sq. ft. Economizer 1620 sq. ft. 3 Todd "Hex Press" Fuel Oil Burners. Diamond Soot Blowers. Auxiliaries available.

BOILER

Mfr. Vancouver Iron Works, Vancouver, B. C. Type: Yarrow, 3 Drum, Bent Tube, Water Tube, Oil fired, 4 Burners. 55,000 lbs. steam per hr. Max. Heating Surface 6256 sq. ft. Working Press. 225 P.S.I. Test Press. 387 P.S.I. Built 2/7/43.

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MODERN 1000 KW Turbo-Generator

In Excellent Condition

Non-Condensing, Steel case 80# back pressure .8 P.F., 3 phase, 60 cycle, 4150/2300 volts, alternating current, complete with accessories, switchboard, oil circuit breaker, and direct connected exciter. Only operated alternately for six years. Ideal for Chemical, Rubber, Petroleum, Textile, Pulp and Paper, and Sugar Refining Industries.

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411 HP 200# ALL NEW TUBES

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Boilers, water walls, stokers, turbo, steam and Diesel Electric units, transformers, air compressors and large motors.

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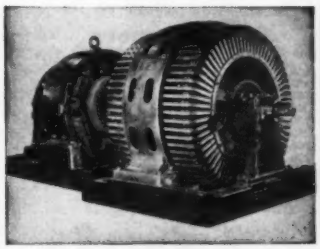
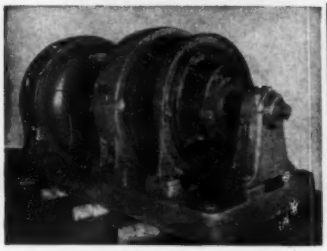
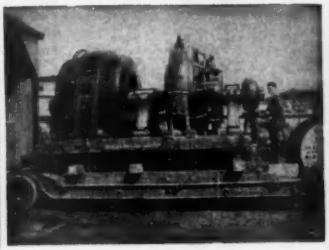


500 KW-MG



750 KW-MG



2000 KW-MG

MOTOR GENERATOR SETS
3 ph. 60 cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
2	2000*	G.E.	580		6600/11000
1	1500	G.E.	600	125/250	4000
1	1500	Whse.	600	600	2300/4600
1	1500	G.E.	360	275	2200/4400
1	1400	Whse.	360	700	2300
1	1000	Whse.	900	600	2300/4150
1	1000	G.E.	900	600	2300/4150
1	800	Whse(3U)	1200	600	2300
1	750	Whse.	900	250	2300
1	500	G.E.	900	600	4150
1	500	G.E.	720	125	2300/4000
1	500	Whse.	900	250	440
1	400	G.E.	720	250	440/2300
1	400	G.E.	1200	120/240	440
1	400	Whse.	1200	250	2300
1	400	G.E.	900	225	2300/4150
1	300	G.E.	900	125	2300-4150
1	150	G.E.	1200	250	2300
1	150	Whse.	1200	275	2300
1	150	Cr. Wh.	1200	250	440
1	140(3U)	Cr. Wh.	900	125/250	2300
1	100	G.E.	1170	125	220
1	100	Delco	1200	125/250	440
1	75	G.E.	1200	125	4000
1	75	G.E.	1200	250	440
6	70	G.E.	1200	70	220/440

* 25 Cycle

ROTARY CONVERTERS
60 Cycles

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1—	2000	G.E.	514	600	13500
1—	1000	Whse.	900	600	11000
1—	750	Whse.	900	600	13200

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	2500	G.E.	Condensing—150# ISP 2300 V 3 ph. 60 cy. with surface condenser. Recently Rebuilt.
1	1000	G.E.	Condensing 135/150# ISP 2300/4150 V 3 ph. 60 cy.
2	750	G.E.	Condensing 425#-725°TT ISP-440V-3 ph. 60 cy. New—1944
1	625	Whse.	Non-condensing, 125/150# ISP. 5/20# B.P., 480 v., 3 ph., 60 cy., with exciter
1	400	Whse.	Non-condensing 125/150# ISP 5/10#BTU 40/480v. 3 ph. 60 cy.
2	400	G.E.	Condensing. 375# ISP Geared to 1200 RPM. 120/240V. D.C. Generator.
1	300	G.E.	Non-condensing 150/175# ISP 5/15# B.P. 480V. 3 ph. 60 cy.
1	300	Al. Ch.	Condensing 425# ISP Geared to 1200 RPM 120/240V. D. C.
2	200	Cr. Wh.	Condensing 250# ISP GEARED to 1200 RPM—125V. D.C. Gen.
1	200	Whse.	Non-condensing 150# ISP 75 B.P. 240V. 3 ph. 60 cy.

D. C. MOTORS

HP	Make	Type	Volts	Speed
1—1750	Whse.		600	525/720
1—1500	Whse.		525	600
1— 940	Whse.	QM-R.Brg.	250	140/170
1— 800/1000	Whse.		450	600/750
1— 650	G.E.	MPC	250	115/145
1— 600	Al. Ch.	MILL	230	460/500
2— 450	Whse.		550	415
1— 300/400	G.E.	DYNA	230	1235/2500
1— 250	Cr. Wh.	CCM-151H	230	1100
1— 225	Whse.	MQ	250	300/900
1— 200/300	G.E.	MPC	230	300/920
1— 250	G.E.	MPC	230	400/500
1— 150	G.E.		600	250/750
10— 150	Cr. Wh.	83H	230	690
1— 150	Cr. Wh.	CMC-65H	230	1150
1— 150	Cr. Wh.	CCM-152H	230	300/1050
1— 50/120	G.E.	MCP	230	250/1000
4— 75	G.E.	TLC-50	250	850/2500

FREQUENCY CHANGERS

1—1000	A.C.	25/62½	Cycle	2300/2300
1—1000	G.E.	25/50	Cycle	4400/2300
1— 500	A.C.	25/60	Cycle	11000/2300V

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Type	Volts	Speed
1	5140	Whse		4150	600
1	4000	G.E.	TSC	2100/4800	900
1	3000	Whse.		4800	720

TRANSFORMERS
60 Cycles

Qu.	KVA.	Make	Type	Ph.	Voltages
2	4000	G.E.	HT	3	22000x2300
3	1250	G.E.	H	1	6600x600
1	1050	G.E.	WCTH	3	11000x445
1	1000	G.E.	HT	3	13200x2300/4600
1	500	Whse.	OISC	1	346°0x482
3	333	Maloney	OISC	1	13200x240/480
2	333	Pitts.	OISC	1	24400x2600
6	300	G.E.	HT	3	13200x240/480
3	300	G.E.	HT	3	6900x240/480
9	300	G.E.	HT	3	2400x240/480
3	150	Maloney	OISC	1	13800x2300/4600
1	100	G.E.	H	1	450x230

RECTIFIERS

1— 750	G.E.	BHW	575	2340
1—1000	A.C.	B-612	625	13500
1—1000*	A.B.B.	GRZ	625	6600/13200

*This unit with full automatic control good for both 25 and 60 cycle.

A. C. MOTORS
3 ph. 60 cycle
SYNCHRONOUS

HP	Make	Type	Volts	Speed
9—3500	G.E.	TS	2300	257
2—3000	Whse.		2300	120
1—1470	Whse.		4600	900
2— 900	Al. Ch.	(New)	2200	150
2— 725	G.E.	ATI	2200/12000	600
1— 650	Whse.	G	2200	138
1— 600	Whse.	Syn.	440	300
1— 600	Whse.	Eng.	2200	128.5
2— 250	G.E.	TS	2200	150
1— 200	G.E.	ATI	440	720
1— 200	Whse.		2300	720
1— 300	Whse.	G	440	900
1— 125	G.E.	ATI	440	450
1— 100	Whse.		550	600

SLIP RING

1—1000	Whse.	CW	2300	444
2— 500	G.E. unused	M-574Y	2200	900
1— 500	G.E.	IP	550	505
1— 500	G.E.	IM-MIII	2200	450
1— 350	G.E.	MT-442-Y	2200/4000	253
1— 300	Al. Ch.	2 Brg.	2300	505
1— 300	G.E.	IM	440	720
3— 300	Al. Chal.	ANY	2300	700
1— 250	Al. Chal.	ANY	440	885
1— 250	G.E.	M-567-TEFC	440	600
1— 250	G.E.	MT-434Y	4000	257
1— 250	G.E.	MT-559S	2200	1750
1— 250	Al. Chal	ANY	550	600
1— 200	Al. Ch.	ANY	440	440
1— 150	G.E.	IM-15	440	885
1— 150	Al. Chal.	ANY	440	580
4— 125	G.E.	MT-566Y	440/2300	435
4— 100	G.E.	MT-566Y	440/2300	435
2— 100	G.E.	IM-16	2200	435
2— 100	G.E.	IM	440	600
5— 100	Al. Ch.	ANY	440	885
1— 100	G.E.	MT-556	2200	900

SQUIRREL CAGE

2— 650	G.E.	FT5503Y	440	3570
2— 450	Whse.	CS	2300/4150	854
1— 200	G.E.	IK-17	440	880
1— 200	G.E.	IW	550	885
1— 200	G.E.	KT-557	440	1800
1— 150	Waghso.	Cs6548	440	880
1— 125	Whse.	MS	440	435
1— 125	(New) G.E.	KF-TEFC	440	1199
1— 125	G.E.	KF-TEFC	440	3885
3— 125	Al. Ch.	AHW	2300	1750
1— 125	G.E.	IK	220	900
1— 100	Al. Ch.	AH	2200	1170
1— 100	G.E.	IK-Vert.	2300	450
3— 100	G.E.	KT-543	220/440	1750

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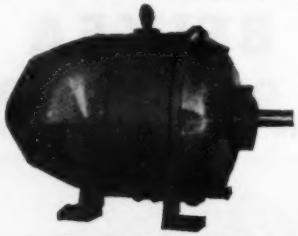
N. Y. LINE - RECTOR 2-7150

MOTORS - M.G. SETS - CONTROLS

NEW AND GUARANTEED REBUILT

DIRECT CURRENT
230 V.
Reconditioned and guaranteed

HP	RPM	Mfg.	Brgs.
150	250/1000	Rel	SI.
75	300/1200	Whse.	SI.
50	500/1500	G.E.	SI.
50	1150	Whse.	SI.
40	400/1200	Rel (TE)	Ball
40	400/1600	Imper.	Ball
35	400/1200	Ideal	SI.
30	250/1000	Whse.	S.SI.
30	500/1500	Rel	Ball
30	700/1400	Rel (TE)	Ball
25	250/1000	G.E.	SI.
25	600/1350	Rel	Ball
25	690	Rel	Ball
25	1150/2300	G.E. (TE)	Ball
20	300/1200	Rel	Ball
20	500/1500	G.E.	SI.
15	250/1000	G.E.	SI.
15	400/1600	Whse.	SI.
15	400/1200	G.E.	SI.
15	575/1000	Rel	Ball
15	575/1725	L.A.	Ball
15	650/1650	G.E.	SI.
15	700/1350	Rel	Ball
10	400/1600	Whse	SI.
10	400/1600	Rel	Ball
10	600/1200	Rel (TE)	Ball
10	850	Rel	Ball
7½	200/1200	Whse. (TE)	Ball
7½	400/1600	Rel	Ball
7½	400/1600	Whse.	Ball
7½	600/1800	Rel (TE)	Ball
7½	1150	G.E.	SI.
5	450/1800	Whse.	S.SI.
3	850/1700	Rel	Ball



NEW DIRECT CURRENT
230 volt-drip proof.

Qu.	HP	RPM	Mfg.	Frame
1	3	690/2660	G.E.	284
10	5	850/1700	G.E.	CD-66
5	7½	575/1725	G.E.	CD-77
1	10	575/2300	L.A.	4051
3	10	1750	Rel.	T-34

CRADLE TYPE DYNAMOMETER
225 HP, Whse, 250 v. DC, 300/2000 RPM, complete with Toledo automatic printing type scale and all necessary control.

NEW MAGNETIC SLIP RING CONTROLS
4—ALLIS 250 HP, 440 volt (125 HP, 220 volt) Reversing, 7 accel. steps, main line air ckt. brkr., fully magnetic, open or enclosed.

M-G SETS

KW	D.C. Volts	A.C. Volts	Mfg.
500	250	2300	G.E.
400	125/250	2300	Ideal
125	250	220/440	Whse.
100	250	2300	G.E.
50	250	440	Ideal
30	250	440	Ideal
20	250	220/440	G.E.
3V5	250	220/440	Rel.

SYNCHRONOUS

HP	RPM	Volts	Mfg.	Type
650	128	2300	Whse.	Engine
400	900	2300	Whse.	80%
300	450	2300	G.E.	100%
300	720	550	G.E.	80%
250	200	440	G.E.	100%
250	514	2300	Allis	80%
200	720	440	G.E.	100%
200	1200	440	G.E.	100%
150	600	440	G.E.	100%
100	1800	2300	Whse.	100%

SLIP RING

HP	RPM	Volts	Mfg.
500	1200	220/440	Elliott (new)
400	900	2300	G.E. (new)
350	450	2300	Whse.
300	600	440	G.E.
200	450	2300	Burke
200	900	220/440	G.E. (new)
100	900	440	G.E. (new)
75	1200	440	G.E. (new)
50	720	220	Whse.
50	900	220	G.E.
40	900	220	G.E.

Buy from BOSWICK with confidence

BOSWICK ELECTRIC CO.

WAlbridge 1195

P.O. BOX 55 — AKRON 9, OHIO

MOTORS - M. G. SETS - COMPRESSORS, ETC.

FAST SHIPMENT

MOTOR GENERATOR SETS
3 ph. 60 cy.

KW	MAKE	RPM	D.C. VOLTS	A.C. VOLTS
1500	G.E.	514	275	2200
1250	G.E.	720	275	2200
730	Allis	514	250	2300
400	West.	720	550	2300
300	Ridg.	1200	250	2300
300	West.	1200	550	4000/2300
200	Ridg.	900	250	2300
200	West.	1200	275	2300
200	G.E.	1200	275	2300
200	G.E.	1200	250	4000/2300
150	Ridg.	900	250	2300
100	G.E.	1200	250	2300
100	Ridg.	1200	250	2300/440
75	West.	900	75	440/220
35	G.E.	1800	125	440/220

ROTARY CONVERTERS

KW	MAKE	RPM	D.C. VOLTS	A.C. VOLTS
500	G.E. HCC6	1200	250	4000/2300
300	G.E. HC12	600	250	4000/2300
300	G.E. HCC6	1200	250	4000/2300
150	G.E.	1200	250	4000/2300

AIR COMPRESSORS
741 CFM, 100#, OCB, Chg. Pr. belted 150 HP motor.
500 CFM, 100#, Allis Rotary direct connected 100 H.P. B.B. Motors.

A.C. MOTORS—3 Ph. 60 Cy.

HP	MAKE	RPM	TYPE
1200	G.E.	277	MT—S.R.
600	G.E.	600	MT—S.R.
400	G.E.	450	MT—S.R.
300	G.E.	450	IM—SI.Rg.
200	G.E.	1200	MI—SI.Rg.
160	G.E.	600	IK-16—Sq. Cg.
150	West.	514	CS954—Sq. Cg.
150	G.E.	600	ATI—Syn.
100 (2)	Allis	720	ARX—Sq. Cg.
100 (4)	West.	1200	CS752C—Sq. Cg.
100 (2)	G.E.	450	IM16—SI.Rg.
75	G.E.	600	ITC5013A
50	West.	1750	CS
50/12.5	G.E.	900/450	IM 2200 v.

Also Smaller Units in Stock

TRANSFORMERS—1 Ph. 60 Cy.

KVA	MAKE	PRI.	SEC.
1—3000 (3 Ph)	G.E.	22000	2300
3—500	West.	22000	2200
3—200	Al. Ch.	22000	2200
3—100	G.E.	2400	120/240
3—50	G.E.	2400	120/240
4—25	West.	2400	120/240

Also Smaller Units in Stock

Send us your inquiries for any POWER EQUIPMENT you may require.

MOORHEAD ELECTRICAL MACHINERY COMPANY
361 Noblestown Road — Oakdale, Penna. — Pittsburgh District

SCOTCH BOILER

300 H.P. International Brady type, A.S.M.E., 150# pressure.

Immediate Delivery.

M. J. HUNT'S SONS
1620 N. Delaware Avenue
Philadelphia 25, Pa.

MOTOR GENERATOR SETS

125 K.W. 250 Volt D.C. Burke 440 Volt 3 phase 60 cycle 900 RPM Synchronous Motor.

100 K.W. 250 Volt D.C. Gen. Elec. 3 brg 440 Volt 3 phase 60 cycle 900 RPM. Synchronous Motor.

50 K.W. 250 Volt D.C. Westing. 4 brg. 220/440 Volt 3 phase 60 cycle 120 RPM motor.

20 K.W. 125 volt D.C. Allis Chalmers 3 brg. 440 volt 3 phase 60 cycle 1800 RPM motor.

D. C. ENGINE GENERATOR

7½ K.W. 220 Volt 500 RPM, direct connected to Engberg 6x5, 150 lbs. S.P. engine

MOTOR REPAIR & MFG. CO.
1557 Hamilton Ave., Cleveland, Ohio

WORLD'S LARGEST INVENTORY

Established 1934 — D & B Rated

ELECTRIC EQUIPMENT CO., ROCHESTER, N.Y. — MAY BULLETIN

MOTOR GENERATOR SETS AC — DC

Quan.	KW	Make	Volts
1	1000	General Electric	250
6	1000	General Electric	600
2	800	Westinghouse	250
2	800	Westinghouse	1500
1	800	Westinghouse	125
1	400	Westinghouse	125/250
2	300	General Electric	125/250
1	300	General Electric	600
1	250	General Electric	250
1	200	Westinghouse	250
1	200	General Electric	250
2	200	General Electric	125
1	150	General Electric	250
1	150	General Electric	125
3	100	General Electric	125
4	100	General Electric	250
1	100	Allis-Chalmers	125/250

Plus 238 sets from 1 KW to 75 KW in stock.

DC TO AC

Input	Output
1 800 HP—230 V	200 KW, 440/60/3
1 125 HP—230 V	75 KW, 125 V, DC
1 25 HP—230 V	15 KW, 230/60/3
1 25 HP—230 V	15 KVA, 230/60/1
35 20 HP—230 V	12½KVA, 440 V, 3 ph, .8 P. F.
40 7½ HP—230 V	7½ KVA, 120/60/1
99 6 HP—115 V	5 KW, 120/60/1
5 3 HP—115 V	2 KVA, 110/25/1
10 1½ HP—115 V	1 KVA, 110/60/1
10 1 HP—115 V	½ KVA, 110/60/1

ROTARY CONVERTORS

Quan.	KW	Make	Speed	Volts
5	500	General Electric	1200	250
7	400	Westinghouse	1200	250
1	100	General Electric	1200	250

P.S.—We Stock Explosion-Proof Motors—Class I-D & 2-G

AC GENERATORS— ALTERNATORS—CONDENSERS

Quan.	KVA-HP	RPM	CYCLE
1	2500	720	60
1	2500	900	60
1	1675	600	40
2	1500	900	60
1	1420	514	60
1	1250	1200	60
1	1000	750	25
1	800	900	60
3	750	900	60
2	650	139	60
1	500	720	60
1	500	750	25
1	400	450	60
2	400	1800	60
1	350	750	25
1	350	720	60
1	250	225	60
1	333	1800	960
1	320	1200	120
1	300	750	25
1	300	180	60
1	250	720	60

Plus 78 smaller units from 3 KVA to 200 KVA

60 CYCLE MOTORS SQUIRREL CAGE MOTORS

HP	SPEED	MAKE
500	720	G. E.
400	1200	West.
400	514	West.
300	600	West.
250	3600	G. E.
250	1200	G. E.
200	600	Al. Ch.
200	1800	Wagner
150	720	G. E.
150	600	G. E.
150	1200	Al. Ch.
150	1800	Al. Ch.

P.S. We stock 3500 new and rebuilt 1 HP to 100 HP

SLIP RING MOTORS

Quan.	HP	Speed	Make
1	600	1800	G. E.
1	500	1800	G. E.
1	500	514	Al. Ch.
4	500	900	G. E.
1	350	720	G. E.
1	300	450	G. E.
1	300	514	G. E.
1	300	900	G. E.
1	300	720	G. E.
1	200	600	G. E.
1	200	1200	G. E.
2	150	720	G. E.
1	125	1200	Al. Ch.
1	100	900	Wagner
4	100	450	G. E.
3	75	720	West.

Plus 637 smaller units 1 HP to 40 HP

TRANSFORMERS

Quan.	KVA	Primary Volts	Secondary Volts	Phase
2	3000	23,000	2300	3
1	1500	2,300	600	3
1	1000	2,300	220	3
6	1000	66,000	7200	1
3	750	2,400	480	1
6	500	2,400	480	1
3	500	12,000	2300	1
3	450	23,060	440	1
3	333	2,400	600	1
3	333	2,400	240/480	1
3	333	13,200	240/480	1
3	333	11,500	240/480	1
3	300	2,400	120/240	1
6	250	2,400	240/480	1

Plus 734 smaller units 1 KVA to 100 KVA

DC MOTORS ADJUSTABLE SPEED—230 VOLT

Quan.	HP	Make	Volts
1	300	General Electric	400/800
1	250	West.	240/675
6	40/250	West.	540/8000
1	150	West.	300/900
1	100	Reliance	500/1500
1	100	G. E.	400/1000
1	100	West.	450/1350
1	100	G. E.	1050/4000
1	90	F. M.	500/1500
1	75	G. E.	400/1200
1	60	G. E.	220/1000
1	60	G. E.	300/1200
1	50	G. E.	250/1000
1	50	G. E.	400/1200
1	40	G. E.	250/1000
1	40	Cr. Wh.	400/1600
1	35	West.	250/1000
1	35	G. E.	500/1000
1	30	Reliance	400/1200
1	30	Cr. Wh.	500/1500
1	25	Reliance	400/1600

Plus 327 smaller units 1 HP to 29 HP

CONSTANT SPEED—230 VOLT

HP OR KW	MAKE	SPEED
400 HP	Elec. Dyn.	1800
300 KW	G. E. (170 V)	1200
300 HP	Cr. Wh.	1800
250 KW	Al. Ch.	720
150 KW	West.	720
125 HP	Star	1200
100 HP	G. E.	900
75 HP	G. E.	1200
75 KW	G. E. 525 V	1200
50 HP	West.	1200
50 HP	Burke	1800

Plus 675 smaller units 1 HP to 40 HP also 115 V & 550 V, DC.

SQUIRREL CAGE AND SLIP RING—25 CYCLE

Quan.	HP	Speed	Make
1	650	365 rpm	S.R.
1	350	750	S.C.
1	300	750	S.C.
1	300	375	S.R.
4	200	500	S.R.
1	200	750	S.R.
1	200	750	S.C.
1	200	500	S.C.
1	200	1500	S.C.

Plus 872 smaller units 1 HP to 150 HP

COMPRESSORS

1—3000 CFM	Ingersoll—Steam
1—3000 CFM	Sullivan
1—1350 CFM	Ingersoll
2— 350 CFM	Ingersoll
2— 400 CFM	Chicago
2— 196 CFM	Ingersoll

We stock new units 6 CFM to 290 CFM

Note: We Stock 6000 New Motors, Controls, Frequency Changers

SEND US YOUR INQUIRIES!

ELECTRIC EQUIPMENT COMPANY

PHONE LD 65

New and Rebuilt — ROCHESTER, N. Y. — 1 H. P. to 2500 H. P.

MOTORS · MG SETS · TRANSFORMERS · CONTROLS · COMPRESSORS

220/440 Volt, 60 cycle **SQUIRREL CAGE** open, 3 Phase

GUARANTEED REBUILT

QN.	HP	MAKE	TYPE	BEARING	SPEED
1	200	G.E.	IK	S.B.	900
1	200	G.E.	IK	S.B.	720
1	150	G.E.	IK	S.B.	600
1	150	G.E.	IK	S.B.	720
1	150	G.E.	IK	S.B.	1800
2	125	Kilby		S.B.*	1800
1	100	West.	MS	S.B.	1200
1	100	West.	CS	S.B.	720
2	100	G.E.	IK	S.B.	720
1	100	G.E.	KT-347	S.B.	1200
2	100	G.E.	IK	S.B.	900
1	100	G.E.	IK	S.B.	1800†
5	100	G.E.	IK	S.B.	1800
1	100	West.	CS-504	S.B.	1800
1	75	G.E.	IK	S.B.	600
2	75	G.E.	IK	S.B.	720
2	75	West.	CS-752C	S.B.	900
1	75	G.E.	K-505	S.B.	1200
1	75	G.E.	IK	S.B.	900†
2	75	G.E.	IK	S.B.	900
4	75	West.	CS	S.B.	1200
4	75	G.E.	IK	S.B.	1200
2	75	F.M.	QS-445	S.B.	1800
2	75	G.E.	IK	S.B.	1800
1	60	G.E.	IK	S.B.	900
1	60	G.E.	KT-348	S.B.	900
1	60	G.E.	IK	S.B.	1200
1	50	F.M.	QS-444	S.B.	1800
1	50	G.E.	KT-333	S.B.	1800
4	50	G.E.	IK	S.B.	1800
1	50	G.E.	IK	S.B.	900
3	50	West.	CS	S.B.	900
1	50	G.E.	KT-342	S.B.	900
1	50	G.E.	KT-342	S.B.	900†
2	50	West.	CS-445	S.B.	1200
1	50	G.E.	KT-327	S.B.	1800
2	50	G.E.	IK	S.B.	1800†
3	50	G.E.	IK	S.B.	1800
1	40	G.E.	KT-542	S.B.	720
1	40	F.M.	BH12D	S.B.	900
1	40	G.E.	KT-336	S.B.	900
1	40	West.	CS	S.B.	1200
2	40	G.E.	IK	S.B.	1800†
3	40	G.E.	IK	S.B.	1800
1	35	G.E.	IK	S.B.	720
1	35	Triumph	B12	S.B.	900
3	30	G.E.	KT-312	S.B.	1800
3	30	G.E.	IK	S.B.*	1800
5	30	West.	K-365	S.B.	3600
1	25	G.E.	IK	S.B.	720
1	25	F.M.	BI2P	S.B.	720
1	25	Century	SC-30	S.B.	1200
1	25	F.M.	BH12A	S.B.	1200
1	25	Ideal	A 18	S.B.	1200
1	25	West.	CS-471	S.B.	1800
1	20	F.M.	KBV	S.B.	1200
1	20	G.E.	KT-322	S.B.	1200
1	20	G.E.	KT-312	S.B.	1200
1	20	G.E.	K-384	S.B.	1800
1	20	West.	CS-184	S.B.	1800
1	20	G.E.	K-328	S.B.	3600
2	20	G.E.	K 385	S.B.	3600
4	20	Line-Weld	Frame 328	S.B.	3600
2	15	West.	CS	S.B.	720
1	15	Wagner	15 T	S.B.	1200
1	15	Ideal	A	S.B.	1200
1	15	G.E.	KT-582	S.B.	1200
1	15	G.E.	KT-752	S.B.	1800
1	10	G.E.	IK	S.B.	1200
1	10	G.E.	KT-752	S.B.	1200

* Splash proof † 2200 volt

SLIP RING MOTORS

We offer from stock the following 220/440 volt, 60 cycle, 3 phase, GUARANTEED REBUILT equipment, unless otherwise noted.

QUAN.	H.P.	MAKE	TYPE	SPEED	DESCRIPTION
1	15	G.E.	MT 512	900	S.B.
1	30	G.E.	MT 532	1800	
1	30	Al. Ch.	ANY	900	
2	40	Al. Ch.	ARY 444	1800	splash proof, S.B.
1	40	G.E.	MT 536	900	S.B.
1	50	G.E.	I-M	900	S.B.
2	60	G.E.	MT 560	600	
1	60	G.E.	MT 560	900	
1	60	G.E.	I-M	900	
1	60	West.	CW 505	1200	
1	75	G.E.	I-M	720	
1	150	G.E.	I-M	720	
1	100	G.E.	I-M	900	
1	125	G.E.	I-M	720	
1	150	G.E.	I-M	900	
1	150	G.E.	I-M	1800	2300 volt
1	200	G.E.	I-M	900	

TOTALLY ENCLOSED MOTORS

FAN COOLED, BALL BEARING, 220/440 volt, 60 cycle, 3 phase, GUARAIITEED REBUILT, unless otherwise noted.

QUAN.	H.P.	MAKE	TYPE	SPEED	DESCRIPTION
1	7½	G.E.	KF 254	1800	
1	7½	Reliance	AA 324	1200	XP, NEW
3	10	L.A.	JS 328	1200	
1	15	West.	CS 328	1800	XP, NEW
1	25	L.A.	JS 364	1800	
1	40	G.E.	K 486	1800	XP, NEW
1	50	Master	FB 484	3600	XP, NEW
1	50	Al. Ch.	ABZZ 444	1800	NEW
1	75	G.E.	K 505	1200	

POWER EQUIPMENT COMPANY

8 CAIRN STREET — P. O. BOX 534 — ROCHESTER 2, N. Y.

Telephone: Genesee 5629

FOR SALE

6 OIL FIRED B&W BOILERS

Heating Surface	**11417 Sq. Ft.**
Horse Power	**1141.7**
Design Pressure	**210 P.S.I.G.**
Working Pressure	**200 P.S.I.G.**
Capacity	**75,000 lbs./hr.**
Steam Temperature	**Saturated**
Furnace Volume	**1024 Cu. Ft.**
Feed Water Temperature	**200°**

The above units presently aboard S.S. George Washington. Installed new 1943. Complete with all oil burning equipment such as Fuel Oil Service Pumps—Heaters—Meters—Burners, etc. Spare refractories. Boilers are Cross Drum Sectional Header Straight Tube type. Excellent for process steam service & manufacturing requiring excess steam. See them aboard the vessel now.

WRITE—WIRE—PHONE: MARINE DEPARTMENT

The BOSTON METALS Co.

313 E. Baltimore St. **Baltimore 2, Md.**

CURTIS 5050-5051

MOTORS

For Laundry Equip.

Louis Allis — Direct Current — Aux. Reverse Control incl.

4 HP—230 V.—1150 RPM Frame 254
1½ HP—230 V.—1150 RPM Frame 224
½ HP—230 V.—1750 RPM Frame 21
½ HP—230 V.—1150 RPM Frame 21

Louis Allis—Vertical Extractor Motor with control & starting compensator. 3 HP—230 V.—D.C.—1750 RPM Frame L430

G. E. 2¼ HP—230 V.—D.C.—500 RPM with speed Regulating Control.

Motor Generator Sets with starting Compensators & overload relay.

Robbins Meyer 15 HP Motor with Westinghouse 10 KW—230 V.—D.C.

Burke 20 HP Motor with Burke 12 KW—115/230 V.—D. C.

***Write* R. K. TOMLINSON**
Business Mgr.
Westtown School, Westtown, Pa.

ELECTRICAL CABLE

- for every Industrial and power application
- Special constructions. Odd lengths.
- Large stocks on hand of high voltage, lead covered cables not ordinarily stocked by your regular suppliers.
- Cut to length. Reasonably priced.

UNIVERSAL WIRE AND CABLE CO.
2668 N. Clybourn Ave., Chicago 14, Ill.

LIQUIDATION SALE — Modern Equipment

DIESEL ENGINES

HP	MAKE	MODEL	RPM	CYCLE
1600	General Motors	16-278A	720	2
1600	Fairbanks Morse	38D O/P	720	2
1800	Hamilton	RB98-D.A.	700	2
900	General Motors	12-567 ATL	750	2
900	General Motors	6-71 (quads)	850	2
450	General Motors	6-71 (Twins)	2100	2
215	Superior	VDM B	800	4

DIESEL GENERATOR SETS

DC	1200 KW	525V	750 RPM	General Motors	16-278A	
	650 KW	240V	750 RPM	General Motors	12-567	
	125 KW	120/240	600 RPM	Superior	VDMB	
	100 KW	120/240	1200 RPM	General Motors	3-268A	
	60 KW	120V	1200 RPM	Buda	909	
AC	200 KW	3/60/450	1200 RPM	General Motors	3-268A	rebuilt
	100 KW	3/60/450	1200 RPM	General Motors	3-268A	rebuilt

3—75 KW, 1200 RPM, 3 phase, 60 cycles, 120-208 Volts synchronous generators, mfg. by Electric Machinery Mfg. Co. belt driven by 110 HP Cooper Bessemer diesels, type GAWD, size 10½x15, 327 RPM (new 1944)

TURBO-GENERATORS—D.C.

1—375 KW 160/240 V GE Shunt. 1200 non-cond.
5—300 KW 120 V Whse. Compd. 1200 cond.
1—300 KW 240 V GE Compd. 1200 cond.
5—150 KW 120 V Whse. Shunt. 1200 cond.
1— 60 KW 125 V 3600 RPM Elliott
12— 60 KW 120 V Whse. Stab. Sh. 1800 cond.
2— 25 KW 125 V 3600

MOTORS—DC

1500 HP 525 V DC 600 RPM Whse.
1362 HP 415 V DC 1200 RPM Elliott
867 HP 375 V DC 1300 RPM Elliott
444 HP 250 V DC 900 RPM Elliott
222 HP 230 V DC 3050 HP Whse
50 HP 230 V DC 525/1800 Whse.
60 KW 125 V 1700 RPM

GENERATORS—DC

1200 KW 525 V 750 RPM All. Chalm.
1075 KW 375 V 750 RPM Elliott
700 KW 240 V 500/720 Elliott
540 KW 110/220/250 V. 1200 West.

AIR COMPRESSOR

2000 CFM at 90 psi, 3 stages, driven by 450 HP diesel mtr. Clark Bros.

HIGH PRESSURE AIR COMPRESSORS
CENTRIFUGES
EVAPORATORS
TRANSFORMERS
SOOT BLOWERS
WINCH TYPE MOTORS

MODERN TURBO GENERATORS AC

5—2000 KW 3 phase 60 cycle 3600 RPM 480/600/2400/4160V type ATB-2 Form HL drives by steam turbine, 410# steam pressure, exhaust 2½" Hg abs., 275 deg. F superheat. General Electric Company. (also 2900 at 1700 V)

2—250 KW G.E. type ATI 3/60/450 1200 RPM condensing.

2—200 KW Westinghse. 3/60/450 1200 RPM condensing (unused).

6—200 KW G.E. type ATB 3/60/450 1200 RPM cond. and non-cond.

GENERATORS—AC

5—2000 KW 3/60/480/600/2400/4160 3600 RPM type ATB-2 Form HL. Mfd. by G.E.

MOTORS—AC

4—6000 HP at 93-1/3 cycle 400 RPM or 3800 HP at 60 cycle 257 RPM—G.E.

ICE PLANTS (New)

2—22 ton capacity, Freon 12, mfd. by Frick.

BOILERS

2—Cyclotherm 3000 pounds steam per hour, 125# press.

1—Express Boilers, modified D type, Foster Wheeler 30,000# steam/hr., 435#.

2—Type "D", water tube, Foster Wheeler, 15000# steam/hr., 275# press.

STEAM TURBINES

All New

1—110 HP 250# steam, 10# Exh. Press. 1200 RPM Sturtevant

10—56.5 HP, 300-475# steam, 10-15# Exh. Press 1225-1800 RPM, Sturtevant

CONDENSERS

(Most are new)

No.	Sq. Ft.	Make	Passes	Tubes	
2	8000	C.H.Wheeler	2	Brass	¾"
3	3300	Str. Wells	2	Alu-Brass	¾"
3	1050	Conseco	2	Cu Ni	¾"
23	400	All. Chalm.	2	Brass	¾"
2	300	Wheeler	2	Cu Ni	¾"
8	155	Conseco	2	Brass	¾"

AIR EJECTORS

1—Foster Wheeler for 3800 sq. ft. cond.
1—Ingersoll Rand 275# press., for 8250 sq. ft. condenser.

32—Diesel engines, G.M. Detroit model 6-71, 2 cycle, twin units, rated 450 HP at 2100 RPM (per unit of two engines). Excellent condition.

AXIAL FLOW FANS

16,000 CFM 3" S.P. 3/60/440 Buffalo
35,000 CFM 1" S.P. 230V DC Wing

BLOWERS — AIR PUMP

5—Blowers, Roots Connersville, size 18x18, serial No. 14862, capacity 5000 CFM against 8 lb. sq. in. gu. pressure or 3450 CFM when creating 20" Hg vacuum.
1—Air Pump, Ingersoll Rand, type FB548, 5500 CFM, discharge press. 24.22 abs., intake press. 20.61 abs., with 125 HP motor 3/60/2300.
1—Air Pump, Ingersoll Rand, type FB548, 6690 CFM, discharge press. 20.86 abs., intake press. 17.10 abs., with 150 HP motor 3/60/2300.
1—Blower, Buffalo, size 60, type R, with 150 HP motor 3/60/2200.
1—Blower, Roots Connersville. Size 20x45.
1—Blower, Wilbraham-Green, size 24½x49.

WIRE ROPE SLINGS

Dia. from ⅝" to 2½"
Length from 10 ft. to 150 ft.

HOISTS

15—15,000# pull at 70 FPM, 3360# pull at 348 FPM and 2 auxiliary drums. Driven by Chrysler 28.35 H.P. gasoline engines (NEW).

HEAT TREATING FURNACES

BOILER FEED PUMPS
FIRE, IRRIGATION AND GENERAL SERVICE PUMPS
OXYGEN PRODUCING PLANTS
WELDING ELECTRODES
REDUCTION GEARS

HUGO NEU CORPORATION

31 Nassau Street New York 5, N. Y.

Tel. REctor 2-1334

Our 30th Year

HEMPHILL EQUIPMENT PROVES ITS VALUE

Member of The National Industrial Service Association, Inc.

TRANSFORMERS—60 Cycle

Qu.	KVA	MAKE	TYPE	Ph.	VOLTAGES
1	1500	GE	Pyranol	3	4150x220/200
1	1000	GE	Auto	3/2	4150 x 2400
1	500	Kuhl.	OISC	1	4600 x 2300V
3	400	GE	H	1	6900 x 2250V
1	300	Pitts.	ODSC	3	7800 x 440V
1	200	GE	HT	3	2300 x 220
1	200	Whse.	Auto	3/2	4150 x 2300
1	200	Pitts.	OISC	1	4000 x 110/220
1	200	GE	Auto	3/2	4150 x 2400
1	150	GE	HT	3	4150-120/208Y new
1	150	GE	KS	1	2300 x 230
1	100	Pitts.		1	2750 x 110/220
3	100	Wagner	RCKV	1	240 x 120/120
2	100	Whse.	SK	1	4400 x 220/440 Taps
2	100	Newark	Dry	3/2	440 x 220
2	50	Whse.	Interteen	1	2400 x 120/240

MOTOR GENERATOR SETS

3 Phase, 60 Cycle

Qu.	KW	MAKE	SPEED	DC	AC
1	1000	GE	514	600	2300/4150 Syn
1	300	GE	1200	250	2300 Syn.
1	180	GE	1200	125/250	2300 Syn.
1	150	Whse.	600	125	4150 Syn.
1	125	CW	1200	125	2300 SC
1	100	CW	1200	125	220/440 SC
1	100	El.Mach.	1200	125	4150 Syn.
3	94	GE	1200	60	440 SC
2	75	GE	1200	250	220/440
2	75	GE	1200	125	220/440 SC
6	75	GE	1200	60	220/440 SC
2	40	El.Mach.	1750	125	440 SC

SLIP RING

1	2500	GE	MT	6600	257
1	350	Whse	CW	440	600
1	200	Whse.	CW	440	600
1	100	GE	IM	440	400
1	75	GE	MT	220	200 Vert.
1	75	GE	MT	440	1900
1	60	GE	MT	220	1750
1	60	GE	MT	440	900
1	50	GE	MT	220	1730
1	50	GE	MT	220	1200
1	50	Whse.	CW	220	900
1	50	GE	MT	220	1700
1	50	GE	MT	220	600
1	40	GE	MT	220	1200
1	40	GE	MT	2200	1200

SPECIAL—Welding Motor Generator Set

1—178 KVA Whse. Welding Gen. S-t, 1 Ph. 220V, 800 Amp 57% PF with Slip Ring Motor & Exiter

THIS SEAL IS YOUR GUARANTEE

"FOR POWER"

J.L. HEMPHILL & CO.

1604 53rd STREET, NORTH BERGEN, N. J.

PHONE NEW YORK—LONGACRE 5-3227

PHONE NEW JERSEY—UNION 3-2600

MOTORS • GENERATORS • TRANSFORMERS

200 KW M.G. SET

200 KW Westinghouse NEMA Frame Generator 250 V DC 1200 RPM direct connected to

300 HP Westinghouse Synchronous Motor 3/60 220/440 Volts 1200 RPM.

AC & DC Panels—Like new. Ship now.

1—400 KW Westinghouse 500 V. DC 750 RPM 800 Amps. Motor—580 HP. Synchronous 3 Ph. 25 cycle 440 V. 750 RPM.

ANODIZING M.G. SET

33 KW Gen. Elect. Type BR. Form C 60 V. DC. Direct connected to 50 HP. 3/60/440/1800 Gen. Elect. Motor.

600 HP GEAR REDUCER

1—600 HP Farrel-Birmingham Herringbone Gear Unit. Type SL. Size 30/16 Speed 730 RPM to 115 RPM.

400 HP GEAR REDUCER

1—400 HP Nuttall (Westinghouse) Type LMR-25 Single Helical Heavy Duty Reducer—6-1 Ratio at 900 RPM with High Speed Shaft Extension for Brake.

400 HP SYNCH. MOTOR

1—400 HP Westinghouse Synchronous Motor. 3/60/2300/900 RPM. Unity P.F. with direct connected exciter—Late Type.

MOTORS

60-50-25 Cycle in Stock—All Sizes. Slipring—Squirrel Cage—Synchronous. All types of Control Equipment.

100 HP Westinghouse Slipring 3 Bearing 3/60/220/440/435 RPM.

100 HP Gen. Electric Type I form K 3/60/2300/600 RPM.

100 HP Gen. Electric Type KT 356 3/60/2200/900 RPM.

125 HP Gen. Electric Type I form K 3/60/440/720 RPM.

125 HP Gen. Electric Type KT 3/60/2300/1200 RPM.

150 HP Gen. Electric Type KT 3/60/440/500 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/720 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/900 RPM.

200 HP Gen. Electric Slipring Type I form M 3/60/440/600 RPM.

200 HP Gen. Electric Type KT 3/60/440/600 RPM.

250 HP Gen. Electric Type KT 3/60/440/720 RPM.

350 KW GENERATORS

2—350 KW General Electric Generators Type MPC, 250 Volt DC, 720 RPM Single Bearing Machines.

MOTORS

250 HP Gen. Electric Synchronous Type ATI 3/25 cycle/2200/500 RPM.

350 HP Westinghouse Slipring Type CW, 3/25 cycle/2200/500 RPM.

400 HP Westinghouse, Synchronous 3/60/2300/900 RPM.

DC CIRCUIT BREAKERS

1—1000 AMP. Condit. 2 Pole

1—1600 AMP. Condit. 2 Pole

1—1600 AMP. Westinghouse 2 Pole

1—3000 AMP. Westinghouse 2 Pole

125 VOLT DC MOTORS

1—100 HP Crocker Wheeler 125 Volt DC 850 RPM Ball Bearing

1—150 HP Crocker Wheeler 125 Volt DC 850 RPM Ball Bearing.

Will make 1200 RPM 125 Volt Generators.

REBUILT TRANSFORMERS

3—100 KVA G.E. 1 ph., 60 cy., 2400/4160 pri., 120/240 sec.

3—1667 KVA Wagner 1 ph., 25 cy., 23,000 pri., 575 sec.

ERIE ELECTRIC CO., INC. 124 CHURCH ST. BUFFALO, N. Y. CL. 4758

If you pride yourself in remembering names, try this one...

"BERGERIZED"

the name that is the GENUINE SYMBOL in REMANUFACTURED MOTORS

"BERGERIZED" BUYS

"SQUIRREL CAGE"

1—300 HP Westinghouse—Type CS—OSB Frame 1106—600 RPM—3 Phase—60 Cycle—2300 Volts.

1—200 HP Westinghouse—Type CS—OSB Frame 950.01H—1200 RPM—3 Phase—60 Cycle—440 Volts.

1—200 HP Wagner—OSB—Type 38T5BH—720 RPM—3 Phase—60 Cycle—2300 Volts

1—150 HP Wagner—OSB—Type 38T5BH—600 RPM—3 Phase—60 Cycle—2300 Volts

10—200 HP Wagner—Type RP2—SB—Frame 26—1800 RPM—3 Phase—60 Cycle—440 Volts

10—75 HP Wagner—Type CPI—TEFCBB—Frame 504—1800 RPM—3 Phase—60 Cycle—220/440 Volts

10—60 HP Wagner—Type CPI—TEFCB—Frame 445—1800 RPM—3 Phase—60 Cycle—220/440 Volts.

• Bergerized motors have a factory guarantee of one year look and will perform like brand new.

"SPECIALS"

"MOTOR GENERATOR SETS"

10—20 KW General Electric Motor Generator Sets—250 Volts DC—Type CDM—BB—1800 RPM—with 30 HP General Electric—Frame 365—Type KF—1800 RPM—3 Phase—60 Cycle—220/440 Volts.

"GEARHEADS"

10—2 HP Westinghouse—TEBB—Parallel Shaft—Type CS—Frame 225—186 RPM—3 Phase—60 Cycle—220/440 Volts.

15—3 HP General Electric—BB—Parallel Shaft—Type MJ Frame 254—103 RPM—3 Phase—60 Cycle—220/440 Volts.

"TRANSFORMERS"

1—100 KVA—General Electric—OISC—Type H—Form KF—Additive Polarity 4160 Volts Primary — 110/220 Volts Secondary—1 Phase—60 Cycle — 3.8% Impedence — Serial #8360225.

1—500 KVA General Electric—OISC—Type H — Form RW — Substractive Polarity—4160/7200 Volts Primary—480 Volts Secondary—1 Phase—60 Cycle — 4.5% Impedance — Serial #5007062.

1—500 KVA—General Electric—OISC—Type H—Form VR—Subtractive Polarity—4160/7200 Volts Primary—480 Volts Secondary—1 Phase—60 Cycle 4.5% Impedance — Serial #5397672

"SLIP RINGS"

10—40/15 Westinghouse — SB — Type CW—Frame 634—1200/600 RPM—3 Phase—60 Cycle—440 Volts.

"D.C. MOTORS"

1—60 HP Westinghouse — Type SK — SB—Frame 160—720 RPM—230 Volts DC Compound Wound Interpole.

1—20 HP Westinghouse — SB — Shunt Wound—Type SK—Frame 83—1200 RPM—230 Volts DC.

"SYNCHRONOUS MOTORS"

1—20 HP General Electric — DPSB — Type T54 — Frame 444Y — 1800 RPM — 3 Phase — 60 Cycle — 440 Volts Direct Connected Exciter.

1—200 HP General Electric—Type ATB—OSB—.8 PF—1200 RPM—3 Phase—60 Cycle—440 Volts.

"DYNAMOMETERS"

1—200 HP Block Test—BB—Type TLC-74 Class 3-200—1650 • 1350/4000 RPM 250 Volts DC.

• All of this equipment is in our own stock for quick shipment at attractive prices.

WRITE • PHONE • WIRE

J.E. BERGER Corporation

4550 MAYBURY GRAND AVE. • DETROIT 8, MICH.

PHONE: TYler 8-4400

PARTIAL LISTINGS OF EQUIPMENT AVAILABLE FOR YOU

MOTOR GENERATOR SETS
3 Ph. 60 cycle

KW	DC Output	AC Input	Speed	Make
1800	250	2300/4000	600	G.E.
800(3U)	400/800	2300	1200	Whse.
400	250	220/440	1200	G.E.-E.M.
300	250	440	1200	Whse.
300	250	2200	1200	A-C
300	250	440	900	Whse.
100	250	4300	1200	Whse.
75	125	440	1200	G.E.
50	250	220	1200	A-C-W
50	125	440	1800	C-W
32	125	440	1800	G.E.
25	230	220	1200	Rel.-G.E.
22	125	220	900	A-C
20	125	220	900	G.E.-A-C
12½	230	220	1800	Whse
10	250	220	1800	Whse.
7½	250	220/440	1800	Whse.
7½	125	220/440	1200	Whse.
5	230	440	1200	Whse.
1	115	220/440	1800	G.E.
300	120	110/220	1800	Cont.

ROTARY CONVERTERS

KW	DC Volts	AC Volts	RPM	Make
1700	250	*	514	G.E.
1100	250	*	720	G.E.
300	600	33000	1200	Whse
150	250	*	1200	Whse.

*Will wind for any voltage

SYNCHRONOUS MOTORS
3 Phase, 60 Cycles

HP	RPM	Volts	Mfr.
3000	720	4800	Whse.
500	514	440	G.E.
435	720	2300	G.E.
430*	750	2300	Whse.
320	900	2300	G.E.
300	1800	2300/4160	G.E.
250**	225	2200	G.E.
225	900	4100	G.E.
220	600	2300	G.E.
220	277	2300	Whse.
200**	150	220	G.E.
175**	225	220	G.E.
160	600	440	G.E.
160	164	440	G.E.
150	1800	2200	G.E.
150	1200	220	Whse.
150	900	440	Star
150*	300	220	Chandeyson
120**	225	220	E-M
115	164	220	G.E.
115	164	220	G.E.
100	1800	2300	Whse.
100	1200	220	Whse.
95	1200	220	Burke
75	1200	220/440	Delco

SPECIAL

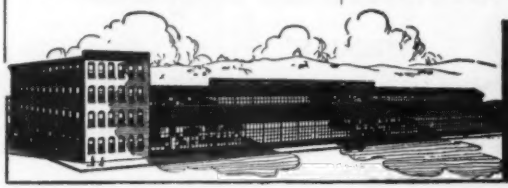
3—G.E. Rectifiers, 500 amp., 6 volt, DC output, 440 Volt, 3 Phase, 60 Cycle input, New Copper Oxide Stacks.

*25 cycles.
**Rotor and stator only, engine type.

SLIP RING MOTORS
3 Phase, 60 Cycles

HP	RPM	Volts	Mfr.
500	900	440	G.E.
500*	900	2200/4160	G.E.
375	1800	2300	A-C
350	514	220/440	G.E.
300	1200	440	Whse
300	720	2200	A-C
300	600	440	G.E.
250	600	440	A-C
250	300	2200	A-C
235	1800	220	G.E.
200	1800	440	A-C
200	440	440	A-C
150	1800	440	G.E.
150	900	2300	A-C
150	720	440	G.E.
150	600	440	A-C
100	1200	440	Whse.
100	720	440	A-C
100	400	440	G.E.
75	720	440	A-C
75	600	440	A-C
60	1800	220/440	A-C
60	900	440	A-C
50	1200	220	F-M
50	900	440	Whse.
50	720	440	A-C
45	1200	440	Whse.
40	900	220	A-C
40	720	2200	A-C
40	600	220	G.E.
40	450	220	Triumph

*New.



GLOW ELECTRIC CO.
927 HARRIET ST. CINCINNATI 3, OHIO
PHONE MAIN 3024

POWER PLANT EQUIPMENT
SPECIAL OFFERINGS

TURBO-GENERATORS

2—4000 KW, 2300 V., 150# Cond.
1—3500 KW, 2300 V., 150# Cond.
1—3500 KW, 4000 V., 150# Cond.
1—3000 KW, 4000 V., 150# Cond.
1—2500 KW, 400 V., 150# Cond.
1—2500 KW, 550 V., 250# Cond.
1—2000 KW, 550 V., 175# Cond.
1—1500 KW, 2300 V., 200# Cond.
2—1250 KW, 2300 V., 225# Cond.
1—1000 KW, 2300 V., 250# Cond.
1—1000 KW, 4150 V., 200# N.C.
2—1000 KW, 480 V., 185# Cond.
1—1000 KW, 480 V., 185# Cond.
1— 750 KW, 550 V., 170# Extr.
1— 750 KW, 2300 V., 175# Extr.
1— 500 KW, 2300 V., 170# Extr.
1— 300 KW, 2300 V., 150# Cond.
1— 300 KW, 2300 V., 200# N.C.
1— 150 KW, 2400 V., 150# N.C.

ENGINE GENERATORS

1—600 KW, 2300 V., Unit.
1—500 KW, 230 V., D.C., Unit.
3—375 KVA, 550 V., Unit.
1—312 KVA, 440 V., Unit.

REFRIGERATION UNITS

3—500 ton motor or turbine driven

BOILERS

2—50,000#, 300#
1—30,000#, 425#
1—25,000#, 150#
2— 500 HP, 200#
3— 500 HP, 400#
1— 450 HP, 200#
2— 400 HP, 150#
1— 150 HP, 150# Sa. Mr.

Write or wire for additional data and prints.

A. LEE ELLIS CO., U. S. Machy. Bldg., 140 Federal St., Boston 10, Mass.
THE BUYERS MUST BE SATISFIED—ALWAYS

AMES MULTI-CYLINDER
Vertical Unaflow Engine

155 HP., 3 cylinders, sizes 10½"x9", left hand unit, 400 RPM., direct connected to Westinghouse generator 120 KVA., 240 volt, 3 phase, 60 cycle. With exciter and switchboards.

CAN BE OPERATED FOR INSPECTION

Immediate Delivery

DENNY & CLARK
1923 W. North Ave., Chicago 22, Ill.

Most all units still on foundation. Many may be seen operating

DIESEL UNITS
240/440/2300 Volts

1000 KVA Elliott-De LaVergne
300 KVA Fairbanks Morse
250 KVA GE-Buckeye
219 KVA (2) Whse.-Buckeye
200 KVA Fairbanks Morse
187 KVA GE-Buckeye
75 KVA (2) General Motors
50 KVA (2) Fairbanks Morse
225 HP Buckeye (belted)

TURBO GENERATOR UNITS
Condensing—Bleeders

7500 KVA Al. Chal. 3/60/2300 V.
3750 KVA Whse. 3/80/600 V. (Bleeder)
3125 KVA GE 3/60/2300 V.; 985#; automatic extraction at 175/200#
2500 KVA GE 3/60/600 V. Cond.
1625 KVA Whse. 3/60/2300 V. (Bleeder)
1250 KVA Whse. 3/60/2300/4150 V. (450#)
1250 KVA GE 3/60/480/240/600 V. (Bleeder)
937 KVA GE 3/60/600 V. Cond.
750 KVA Al. Chal. 3/60/480/240 V.
625 KVA GE 3/60/2300 V. (Bleeder)
625 KVA Whse. 3/60/600 V. Cond.
375 KVA Whse. 3/60/240/480 V. Cond.

TURBO GENERATOR UNITS
Non-condensing

375 KVA (2) Al. Chal. 3/60/240/480 V.
250 KVA GE 3/60/2300/600 V.
125 KVA GE 3/60/240/480 V.
62 KVA GE-DeLaval 240/480 V.

STEAM ENGINE SETS, A.C.
480/240 Volts

625 KVA GE-28x32 Chase 4 V.
450 KVA GE-Ames Unit. (Cond.)
450 KVA GE-23x28 Chase 4 V.
312 KVA (2) CW-23x24 Skinner Unit.
219 KVA GE-18x20 Ames Unit.
187 KVA Whse.-Ames Unit. (Vertical)
125 KVA Whse.—Ames Unit.
62 KVA GE-13x14 Ames Unit.

BOILERS

100,000# B&W type F; 850#
30,000# B&W type F; 425#
500 HP Cleaver Brooks 150# (New)
427 HP Bigelow, 3 drum, low hd.
333 HP Bigelow, 3 drum, low hd.
332 HP (2) B&W type H 100#
220 HP (2) Vogt 3 Dr. Low Hd. 100#
200 HP Erie City self contained 100#
150 HP (3) Murray, low Hd. 250#
150 HP Scotch Marine, 125#
125 HP Kosler Economic, 125#

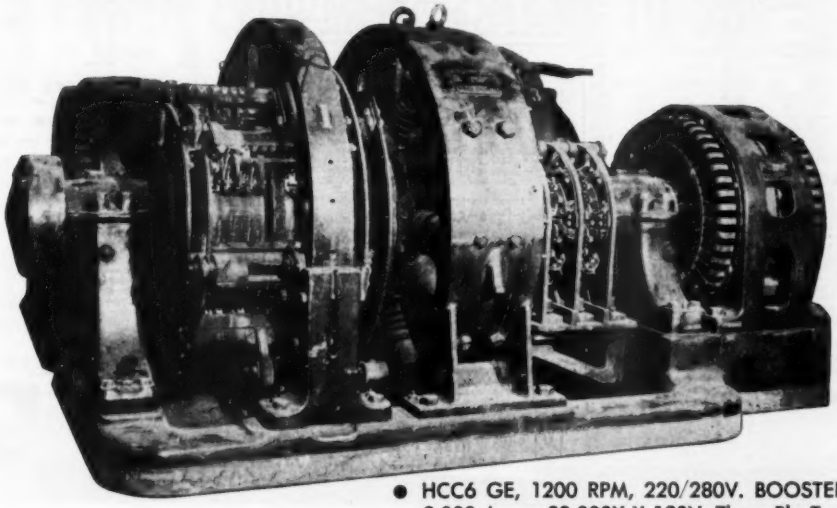
TRANSFORMERS

500 KVA (3) Pittsburg 6900/550 V.
400 KVA (3) Whse. 2300-230/460 V.
333 KVA (3) Pittsburg 2300-230/460 V.
250 KVA (3) G.E. 11430/6900-575 V.

Above listed units are only a few of our "SPECIALS." Advise your plant requirements.

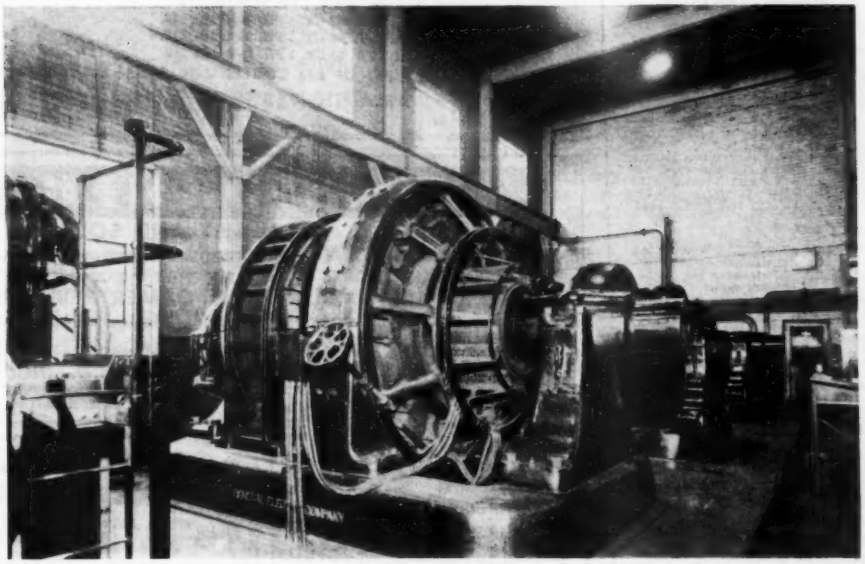
POWER PLANT EQUIPMENT CO., INC. 39 Cortlandt St. New York, N. Y.

★ 500 KW SYNCHRONOUS CONVERTERS



● HCC6 GE, 1200 RPM, 220/280V. BOOSTER TYPE, 2,000 Amps. 23,000Y X 190V. Three Ph. Transformers. Manual Switchgear.

★ 1000 KW MOTOR GENERATOR SETS



● ATI, 1400 HP, 3/60/13,200, 514 RPM, MPC-H, 600V. DC, CONTROLS FOR DC ONLY.

SAMUEL M. DAVIS

510 LA SALLE ST.
ST. LOUIS 4, MO.

SLIP RING MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Speed
500	2300	G.E.	450
450	440/230	Whse.	514
400	2300	G.E.	1200
350	2200/440	G.E.	450
300	440	Whse.	3600
250	440/230	Whse.	600
250	2300/550	G.E.	450
250	550/440	G.E.	1200
200	440	G.E.	450
200	440	G.E.	600
198	4000/2300	G.E.	1200
150	440/230	Whse.	600
150	440/230	Whse. (2)	1200
145	4000/2300	G.E.	1200
125	550/440	G.E.	1200
100	440/230	G.E.	900
100 (2)	440/230	Whse.	900

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
400	440/230	G.E.	ATI	600
300	2200/440	G.E.	TS	720
300	440/230	G.E.	ATI	600
250	440/230	Whse.	MR	277
250	440/230	G.E.	ATI	600
250	4000/2300	El. Moto.	Syn.	900
240	2200/440	G.E.	ATI	720
200	4150/2300	Whse.	G	1800
125	440/230	G.E.	ATI	900
110	440/230	G.E.	TS	257
104	440/230	Whse.	G	1800
75	2200/440	Whse.	GE	600

PLATING UNIT

1—5,000 amp., 4/8 volt (or 2,500 amps., 8/12 volts) A.P. Munning, double commutator, dir. conn. to 50 hp. G.E. sq. cage motor.

CIRCUIT BREAKERS

2—2000 amp., GG E. 3 pole, 600 v., air
2—1600 amp., ITE, 3 pole, 600 v., air
2—1200 ampere, Whse., 3 pole, 600 v., air
1—400 amp., 37500 V., G.E., Type FMKO-238 outdoor type, high interrupting capacity.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
600	440	G.E.	FT	3600
500	2300/4000	Elliot	SC	1200
350	2200	G.E.	KT	1200
300	2200	G.E.	FT	3600
250	440	G.E.	IK	720
200	440	G.E.	IK	514
200	440/220	Whse.	CS	1200
200	440/220	G.E.	KT	1200
200	2300/440	G.E.	KF	720
200	2300/550	Cr. Wh.	SC	900
200	2300/440	G.E.	KT	1200
200	440/220	G.E.	IK	450
150	440/220	Whse.	CS	900
150	440/220	G.E.	IK	450
100	2300/550	Whse.	CS	900
150	440/220	G.E.	KT	720
150	440/220	Howell	H. Brg.	1800
150 vert.	440/220	G.E.	KTF	1200
150	440/220	G.E.	IK	514
150	2200/440	G.E.	KT	600
100	2300/440	G.E.	K	1200
75 (5)	550	G.E.	KF	1800

A. C. GENERATORS

1—320 kva, 600 rpm, 2300/440/220 V., G.E
1—250 kva, 720 rpm, 2300/440 v., G.E.
1—225 kva, 600 rpm, 220/440 v., G.E.
1—225 kva, 720 rpm, 2300/440 v., G.E.
1—150 kva, 900 rpm, 440/240 v., G.E.
2— 75 kva, 1800 rpm, 440/240 v., Whse.
1— 50 kva, 1200 rpm, 440/220 V., G.E.

D. C. MOTORS

HP	Volts	Make	Type	Speed
350	230 (2)	G.E.	CD	1150
250	230 (3 new)	Cr. Wh.	CMC	1800
150	230 (2)	Whse.	SK	850
150	230	Cr. Wh.	TEFC	900
100	230	Cr. Wh.	CMC	925
100	230	G.E.	CD	1750
75	230	G.E.	CD	1150
75	230	Whse.	SK	850

MOTOR GENERATOR SETS

1—100 kw, 1200 rpm, 240/120 V., Al. Chal., conn. to 150 hp, 440 V., sq. cage.
1—100 kw, 250 v., Hertner, 1200 rpm, connected to 150 hp, 220/440 v., synchronous
1—75/90 kw, 250 V., 1200 rpm, G.E. conn. to 135 hp, 440/220 V., sq. cage
1—75 kw, 125 v., 1200 rpm, G.E. conn. to 120 hp, 2200/440 v., syn. motor
1—65 kw, 1200 rpm, 250 V., G.E., conn. to 100 hp, 1200 rpm., 440 V., synchronous
1—50 kw, 250/125 V., 1200 rpm, 3-wire, G.E., conn. to 75 hp, 440/220 V., sq. cage

TRANSFORMERS 60 Cy.

3—333 kva, G.E., 13,200—2300 V.
2—333 kva, G.E., 4000/2300—230/460 V.
3—300 kva, Whse., 13200—440 V.
3—250 kva, Whse., 11,000/22,000—2300 V.
3—250 kva, Whse., 2300—208 V.
3—200 kva, Whse., 13,200—2300 V. (Inertseal)
4—200 kva, Moloney, 2400—220/460 V.
3—150 kva, Whse., 2400—240/480 V.
3— 75 kva, Moloney, 4150—240 V.
3— 75 kva, G.E., 2400—240/480 V.
6—150 kva, Al. Chal. 2400—240/120 v.
1—150 kva, Whse. SK, 13200-125/215 v., 3 ph.
2—75 kva, G.E., 480—240/120 V., Pyranol
3—50 kva, G.E., 480—240/120 V., Pyranol

STEPHEN HALL & CO.

HARRY J. RICE PRES.

458 SEVENTH ST. HOBOKEN, N. J.

BOILERS

THREE (3) FINE COMPLETE BOILER PLANTS

—READY TO OPERATE! IMM. DELIVERY

- ***PLANT NO. 1:***

1—20,000 lb/hr ERIE CITY, 3C 3-Drum Bent Tube, Water Tube BOILER, 160# opr. pr.; LIKE NEW. Installed 1948. USED LESS THAN 2 MOS. Now erected for inspection. Includes Sup. Steel; Breeching, Peabody Oil Burners with Pre-Heaters; Soot Blowers; Cond. Pump; Blowers; Piping; Gauges; Feed Pump; Stack. A REMARKABLY FINE PLANT. SHIPMENT 2 WKS. LOCATED NYC. BARGAIN PRICE FOR QUICK SALE.

- ***PLANT NO. 2:***

1—45,000 lb/hr BABCOCK & WILCOX Sec. Hdr., Str. Tube, Cross Drum, Water Tube BOILER, 160# W.P. Includes 100 dg. Superheater; Soot Blowers; almost NEW Combustion Engr. Spreader Stoker (if desired); Comb. Controls; Deserating Heater; Feed Pump; Meters; Sup. Steel; Panel Board; Valves; Piping; Breeching; Water Softener; etc. Located Northern N. Y. State. INSPECTION INVITED.

- ***PLANT NO. 3:***

3—330 HP ERIE CITY 3-Drum Bent Tube, Water Tube BOILERS. (Ship in 1 Pc) 160# WP; Blt. 1942; Excel. Condition. Incl. Sup. Steel; Chicago Spreader Stokers (if desired); Soot Blowers; FW Regulators; Pumps; Piping, etc. Located Missouri.

LATE MODEL CLEAVER-BROOKS GENERATORS 1-15 HP, 125#; 2-20 HP, 125#; 1-60 HP, 120#. ALL IN GOOD CONDITION.

ASK US FOR QUOTATIONS ON:

BOILERS—10 HP to 1000 HP
DIESEL GENERATORS
TURBINE GENERATORS

Send us your specs. We will try to match them with good used equipment.

USED EQUIPMENT DEP'T.

J. PARKER THOMPSON CO., Inc.
507 Fifth Ave., NYC MU. 7-6547

TRANSFORMERS

FOR SALE

2— 150 KVA. 60 CY. 1 PH. 2400-240/480 SCOTT TAPS.
6— 100 KVA. 60 CY. 1 PH. 2400-240/120.
6 75 KVA. 60 CY. 1 PH. 2400-240/120.
9— 50 KVA. 60 CY. 1 PH. 2400-240/120.
7—37½ KVA. 60 CY. 1 PH. 2400-240/120.
8— 15 KVA. 60 CY. 1 PH. 2400-480/240.

ALSO ALL TYPES OF AIR COOLED AND PHASE CHANGERS.

ATLANTIC TRANSFORMER CO.
5143 N. 2nd St. Philadelphia 20, Pa.

—TRANSFORMERS—

BOUGHT AND SOLD

We carry a large stock of transformers, and invite your inquiries.

PIONEER TRANSFORMER REBUILDERS

We rewind, repair and redesign all makes and sizes.

One Year Guarantee.

THE ELECTRIC SERVICE CO., INC.
"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
SINCE 1912 CINCINNATI 27, OHIO

BOILERS FOR SALE

4—250 HP Stirling 100 lb.
1—434 HP Stirling 100 lb.
5—Kewanee Locomotive type C 7L87
4—Ideal C.I. sectional rated 7360 sq. ft.

used 3 years—all good condition

SHERMAN SALVAGE COMPANY
2452—1st Ave. So., Seattle 4, Wash.

TRANSFORMERS

3—1667 KVA 33. K.V. to 6.9 with taps above and below.
3—1000 KVA same specifications.
These transformers practically new. Purchased 1943 used short time.

PHILA. TRANSFORMER CO.
2829 Cedar St. Phila. 34, Pa.
GArfield 6-1800

100,000 & 50,000 Gal. Tanks & Towers
10,000, 16,500, 18,000 Gal. Steel Tanks
3—500 & 350 HP Erie City WT Boilers
2—120 & 200 KW Diesel Electric Sets
125, 312, 675 KVA Engine—Generator Sets
500 & 1500 KW Westgo. Turbo. Gen. Sets
75, 100, 125, 200 & 300 HP Motors

H. & P., 6719 Etzel, St. Louis 14, Mo.

POWER EQUIPMENT—READY TO SHIP

A.C. MOTORS
220/440 volt 3 ph. 60 cy.

Qua.	HP	Make	RPM	Type
1	250	Burke	720	syn. (2300 v.)
1 vert.	250	G.E.	1175	I-E. 15 s.
1	250	G.E.	1175	(2200 v.)
5	250	Westg.	1775	CS-8758 drip proof
5	200	Wagner	1750	RP-2
1	200	G.E.	1800	syn.
1	150	Westg.	257	syn.
1	150	Westg.	500	CS-954A
4	150	Westg.	1150	CS drip proof
1	150	Westg.	1200	MS-hi-torq
1	150	G.E.	720	I-K-564
1	125	Elec. Mach.	164	syn.
1	125	Westg.	450	CS-954-A
1	125	Westg.	600	syn.
4 New	125	Westg.	1200	syn.
1	100	Westg.	600	syn.
1	100	Westg.	900	syn.
1	75	Stanley	600	
1	75	Allis Chal.	585	
1	75	G.E.	720	I
1	75	G.E.	900	I-K
2	75	Elec. Mach.	900	syn.
1	75	Allis Chal.	1750	2200 v.
1	75	G.E.	1200	KT-346
1	60	Allis Chal.	514	
2	60	G.E.	1750	KT-533
1	60	Triumph	1200	B-133
1	50	Triumph	860	
2	50	Westg.	900	CS-550 v.
1	50	G.E.	900	KT-346
5 New	50	G.E. 2200V. (T.E.F.C.—B.B.)	1750	K-504U
1	40	G.E.	870	KT-546
1	40	G.E.	720	KT-346
1	40	G.E. (Hi-torq.—hi-slip)	1630	KR-444
1	30	G.E. (hi-torq.)	790	KR-444
1 New	30	Westg. (Linestart—hi-torq.)	900	CS-445
2	30	G.E.	3600	KT-205
2	25/7.5	Continental	1150/575	
1	25/6.2	Continental	1150/575	
1	25	Howell	1200	SC
3	25	G.E.	1150	KT-322
1	25	Westg.	1160	CS-405
1 New	20	Reliance	580	C-445
1	20	G.E.	880	KT-5325
1	20/7½	G.E.	1165/425	K-504
1	30	L.A.	870	Ex.-405-exp. pr.

SLIP RING MOTORS
3 ph.—60 cy.

HP	Make	RPM	Type	Volts
600	Ideal	1170		440
500	Ideal	1170	AYN	440
400	Westg.	438	HF	2200
300	Allis Chal.	585		2200
200	Westg.	580	CW	220/440
100	Triumph	580	C-17	550/220/440
75	G.E.	450	M-6335	220/440
60	Westg.	1160	CW-644C	220/440
60	G.E.	570	MTC-5348	220/440

SPECIAL BARGAINS
Diesel Engine Generator Sets

10—100 kw., 120/240 v. D.C. Delco Generators dir. con. to 150 HP Model GBD-8, 8½x7, 8 cyl. Superior DIESEL Engines, elec. start with engine panels
4—100 KW same as above with 220 or 440 v. NEW A.C. Generators
1—86 kva. Fairbanks Morse 220/440 v. 3 ph. 60 cy. 360 rpm DIESEL
1—30 kw. 125 V. D.C. with dir. con. Buda DIESEL ENGINE
4—25 kva. 220 or 440 v. 3 ph. 60 cy. 900 rpm., LaRoi Gasoline
5—25 kva. 120 v. 1 ph. 60 cy. LaRoi Gasoline
1—10 kw. 240/120 v. 1 ph. 60 cy. Hercules Gasoline
1—7½ kva. 220 v. 3 ph. 60 cy, Wisconsin Gasoline
1—5 kw. Onan 110 v. 1 ph. 60 cy. Gasoline complete

NEW EXPLOSION PROOF MOTORS

2—3 HP., 1750/3500 rpm 230 V D.C. Reliance.
3—7½ HP., 1750/2190 rpm 230 V. D.C. Reliance.

NEW SINGLE PHASE MOTORS
110/220 v. 60 cy.

15—¾ HP G. E. 1145 rpm type KCJ-204, drip proof.
8—1½ HP Westg. 1725 rpm B.B. Type CAP-204.
8—2 HP Westg. 1160 rpm type CU-254.

CRANES

1 ton Euclid Overhead 29'6½" span, 8' lift, 220/440 v. 3 ph. 60 cy.
1 ton Euclid Overhead 29'10½" span, 8' lift, 220/440 v. 3 ph. 60 cy.

GEARHEAD MOTOR

1—NEW 10 Hp., Westinghouse 220 v. 3 ph. 60 cy. 1200 rpm., to 20 rpm type FD-326F, frame W326 type CS

MOTOR GENERATOR SETS—
250 V. D.C.
Motors 220/440 volt or 2200 volt

No.	KW	Make	Rpm
2	200	Westinghouse	1200
1	100	Westinghouse	700
1	100	General Electric	900
1	100	Westinghouse	600
1	100	General Electric	1800
1	100	Reliance	580
1	100	Delco	1200

TRANSFORMERS
1 ph. 60 cy.

No.	Kva	Make	Primary	Sec.
3	500	West	22000	2200
3	500	Pgh.	22000	2200
3	200	Pgh.	4800	120/240
5	200	Allis Chal.	4800	120/240
2	150	Pgh.	4600	115/230
1	110	Pgh.	4600	115/230
6	100	Pgh.	4800	115/230
2	100	Allis Chal.	4800	120/240
2	100	G.E.	4800	120/240
1	75	Pgh.	4800	115/230

ENGINES

NEW 75 HP. F.&H. Model 387C 3 cyl. Diesel
Rebuilt 32 HP. Caterpillar Model D-3400 Diesel
NEW 43 HP. International Model U-6 4 cyl.

NEW AXIAL FLOW VENTILATING FANS

20—6000 cfm Sturtevant Bulletin 512389 2" stat. pres. 7 blade dir. con. 5/1.5 HP 1765/1175 rpm 220/440 v. 3 ph. 60 cy. Westg. TEFC Motors
5—5000 cfm 3.2" stat. pres. Sturtevant with 2 speed 220/440 v. 3 ph. 60 cy. Motors
2—10,000 cfm LADEL dir. con. 2 speed 220/440 v 3 ph. 60 cy. Motors
1—12000 cfm 2" stat. pres. with 2 speed 220/440 v. 3 phase 60 cy. Motors
2—16000 cfm 3" stat. pres. Buffalo Forge with 2 speed 220/440 v. 3 ph. 60 cy. Motors

AUTO TRANSFORMER

3000 kva. output 22000 Y to 2300 v. 3 ph. General Elec.

BAKER LOCOMOTIVE CRANE TRUCK

Model CYA 3000 lbs. at 7' radius with 8 to 12' adjustable telescoping boom complete with slow control, hoist control and boom control.

SPECIAL BARGAIN
550 V. M.G. Sets

2—500 kw. Crocker Wheeler 575/600 v. 720 rpm., dir. con. 4160 or 2300 v. 3 ph. 60 cy. Syn. Motors with swbds.

WRITE, WIRE OR PHONE YOUR ELECTRIC NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US.

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

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600 KW DIRECT CURRENT GENERAL MOTORS DIESEL SET, WESTINGHOUSE Generator, 500 Volt, 720 RPM, Electric Start. Unused.

450 HP ENTERPRISE DIESEL ENGINE. Model DSG-8, 8 Cyl., 4 Cy., 450 RPM air start, solid injection. Unused.

Various other sizes in stock.

ALJON ELECTRIC DIESEL CO.

904 Pacific St. Brooklyn 16, N. Y.

STerling 3-6515

COMPLETE POWER PLANTS

STEAM — ELECTRIC — HYDRO — DIESEL

"Expert Orders Carefully Executed"

BOILER UNITS

1—100,000# cap., 350# Steam Gen., 85% efficiency.
3—600 HP B&W Sectional header 250#
2—60,000# capacity 450# Boiler with superheat
2—52,000# ea. cap. 450# Generator, 8/heat airheater
2—1600 HP Stirling type Boilers 250#—super
2—650 HP B&W Stirling type Boilers
1—900 HP Bent Tube Express Type Boiler, 200#, ASME
2—516 HP; 2—315 Heines 165# several 200 HP Boilers
1—500 HP B&W Steel Sectional Header Boiler
2—400 HP B&W Steel Sectional Header Boilers
Also smaller Boilers & Fire Tube Boilers

TURBO UNITS

2—10,000 KW Turbo-Generator—Cond.
1— 7,500 KW Turbo-Generator—Cond. 600#
1— 5,000 KVA Turbo-Generator 450# with condens.
2— 5,000 KW Turbo-Generator—Cond.
1— 3,000 KW Turbo-Gen. and Cond., one ext. extras.
2— 2,500 KW Turbo-Generators and Condensers
3— 2,000 KW Turbos & Condenser
2— 1,500 KW Turbos & Condenser
2— 1,250 KW Turbos & Condenser
2— 1,000 KW, also 750 & 500 KW Units, Condens.
Non-Cond. :—500—500—750—1000—1500—2000

Frequency Changers—Motor-Generators & Diesel-Generators

TRANSFORMERS! Quick Delivery, Various Sizes Rebuilt like NEW—Guaranteed.

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BOILER SALE—MAY SPECIAL

WANTED: QUICK SALE

1—Combustion Engineering, 70,000# steam per hour, 450#, 750° FTT
1—B & W, 100,000# steam per hour, 850#, 825° FTT

COAL, GAS, OR OIL FIRED

CHARLES WEAVER, Owner 4145 PENOBSCOT BUILDING, DETROIT 26, MICHIGAN

DIESEL

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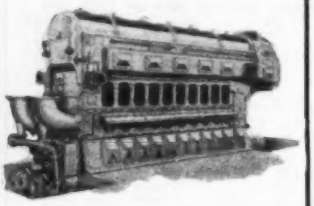

FAIRBANKS-MORSE
Model 38-D-8-1/8
10 CYL.—Opposed Piston
Direct Reversible Engine

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GENERATOR

TURBO GENERATORS

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150 KW DC 120 V.
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200 KW DC 120 V.
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500 KW AC 450 V.
(ONE ONLY)

UNITS

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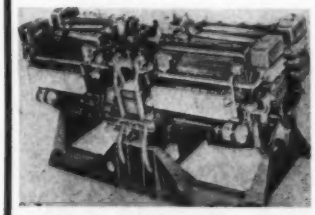

GM 6-71 QUADS, SINGLE ENGINES

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DIESEL DIVISION
NATIONAL METAL & STEEL CORP.
Dept. P, Terminal Island
(Los Angeles Harbor), Calif.
Phone Los Angeles: Nevada 6-2517

BOILERS, TURBINES, EQUIPMENT

1—65,000 lbs. per hr. BOILER, 450# pressure. Complete with all fixtures and trim, sectional steel header, straight tube type.

6—600 H.P. B&W BOILERS, 200# pressure, Straight tube type.
The above boilers are ready for delivery in April and August.

1—100,000 lbs. per hour BOILER, 650# pressure, complete. Delivery in July.

Turbo-Generators, Power Equipment, M.-G. Sets, Diesel Engines, etc.

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342 MADISON AVENUE, NEW YORK 17, N. Y.
PHONE: MURRAY HILL 2-8562

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have the best
POWER PLANT EQUIPMENT
Boilers, all types
Turbo Gen's condensing non condensing
Large Motors and M-G's
DIESELS TRANSFORMERS
? What do you require ?
630 Fort Washington Ave., N. Y. 33, N. Y.

BOILERS

1 Erie 400 HP Str. tube 200 lbs. sprdr. stoker
1 Murray Type A 200 lbs.
1 Leffel 40 HP Scotch 100 lbs.
F. W. HAY AND CO.
2734 Cherry St., Kansas City 8, Mo.

FOR SALE

1—300 KW, 220 DC Eliott Turbine Generator—A-1 Condition.
W. L. MARTIN, II, Trustee
Box 476 Bridgeton, N. J.

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New and used equipment recently released from service by a number of electric and gas utility companies

POWER PLANT EQUIPMENT
CONSTRUCTION EQUIPMENT
SUBSTATION EQUIPMENT
TRANSMISSION LINE MATERIALS

Send for new list . . . to

EBASCO SERVICES INCORPORATED
APPARATUS EXCHANGE
Two Rector St., New York 6, N. Y.

FOR SALE

3—1667 transformers, single phase, GE Co., Prim. 2300/4600/13,800 V Sec. 2300/4600 V, Type H Form VDD 60 Cycles 018C
3—1000 KVA transformers single phase Prim. 13,800 V Sec. 2400 V, Pittsburgh water-cooled
HOLYOKE WATER POWER COMPANY
1 Canal Street, Holyoke, Massachusetts

BOILER

281 H.P. Farrar & Trefts 1943—125#, series 500 with Detroit stoker.
MALLORY MACHINERY CO.
525 W. Conway St., Balto. 30, Md.

TRANSFORMERS

13,200/2,300 60 cy. 1 PH.
3—150 KVA, GE.
3—200 KVA, GE.
3—250 KVA, GE.
ANDREN-MYERSON CORP.
411 Atlantic Ave. Boston 10, Mass.
Tel. Liberty 2-4300

SELLING FOR CUSTOMERS

2000 KW 2300/3/60 G.E. 450 lb. condensing turbine.
1000 KW 2300/3/60 G.E. 175 lb. operating pressure.
300 KW Westh. 150 lb. non-condensing turbine.
(3) 1200 amps. 600 V. 3-pole Westh. air breakers.
150 HP 720 RPM 220/3/60 G.E. Syn mtr. with Str.
30 & 200 KW M.G. Sets Gen. 230 volt D.C.
H. BLANE JOHNSON & Associates
55 W. Jackson Blvd., Chicago 4, Ill.

FOR SALE

35 ft. Godfry Conveyor, 220-440V. 3 ph. 60 cy. Self propelled. Cap. 90 tons per hour.
3 Weiman Centrifugal Pumps 4 inch pipe size. 220-440 V. 3 ph. 60 cy. 7½ H. P. 1150 R. P. M. —like new.
C. B. STRAYER
148 N. West Street Carlisle, Penna.

GENERATORS

Steam driven, quantity four (4) Maker—American Engine Co., Bound Brook, N. J. Offered, "as is" in present location. At $1500.00 for lot or will sell separately. Estimated cost of removal, loading assembled for all four, $3500.00. Automatic cut-off, condensing or non-condensing. Three are 52 H.P., 120V, DC, 415 Amps; one 125 H.P., 116V, 910 Amps. Excellent condition; will operate for detailed inspection. Send for details.
C. H. RUTH, JR.
c/o Evening Star Newspaper Co., Wash. 4, D.C.

FOR SALE

Cheap, 2 brand new type 24PJ8 Fire Eye Control Mechanisms manufactured by Combustion Control Corp., Cambridge, Mass.
North Platte Rendering Co.
North Platte, Nebraska

FOR SALE

Diesel Engine Superior type KNA 500 HP, 514 RPM directly connected to a 300 KW Westinghouse DC Generator. Can be purchased as one unit or separately.
IRWIN COHEN
1351 Somerset Rd., West Englewood, N. J.
Teaneck 6-5325

MOTORS — M.G. SETS — TRANSFORMERS

SQUIRREL CAGE MOTORS
3-Ph., 60-Cy.

Qu.	HP	Make	Type	Volts	RPM
1	400	G.E.	IK	2300	514
1	400	G.E.	KT-412	2300	450
1	250	Whse.	CS	2200	1160
1	200	Al.Ch.	AR	220/440	580
2	125	Al.Ch.	AR	2200	1750
1	125	Whse.	CS-761	440	1750
1	125	G.E.	KT-568	2300	875
2	125	C.W.	1252	440	430
3	100	Whse.	CS-963	440	1750
1	100	Al.Ch.	AR-226	2200	1160
1	100	Al.Ch.	AR	550	690
1	100	F.M.	H-241B	440	450
1	100	Whse.	CS-938	2200	514

SYNCHRONOUS MOTORS
3-Ph., 60-Cy.

Qu.	HP	Make	P.F.	Volts	RPM
1	1500	Whse	.8	2200	720
1	700	G.E.	.8	2300	720
1	400	Whse	.8	440	600
1	268	Al.Ch.	1.	2200	900
1	150	G.E.	1.	2200	900
1	150	G.E.	.8	550	450
1	150	G.E.	.8	2200	600
3	125	El.Mach.	1.	4800/2400	900
1	125	G.E.	.8	2200	900
3	100	Whse	.8	440	1800
1	100	Whse	1.	2200	1200
1	100	Ideal	.8	440	900
2	100	G.E.	.8	440	600

With the above we can supply manual, semi-magnetic or full magnetic, reduced or full voltage control.

SLIP RING MOTORS—CONSTANT DUTY—3-Ph., 60-Cy.

Qu.	HP	Make	Type	Volts	RPM
1	3000	G.E.	MT	2200	356
2**	1000	Al.Ch.	ANY	2200	235
2	500	G.E.	1-16-M	2300	450
1	500	Whse	CW	2300	514
1	500	Al.Ch.	ANY	2300	504
1***	400	G.E.	MT-574	550	585
1**	400	G.E.	1-M	2300	560
1**	400	Al.Ch.	ANY	2200	565
2	400	G.E.	MT-412	2200	440
1	300	G.E.	I-E15-M	2200	1200
1	300	Al.Ch.	ARY	2200	505
1	250	G.E.	MT-414	2200	300
1	200	G.E.	I.M.	2200	585
1	150	G.E.	I-E13-M	2200	1750
1	150	Whse	CW	2300	600
1***	125	Whse	CW-870	2200	900
1	100	F.M.	420-C	440	900
1	75	G.E.	I.M.	440	695

** Mill type pedestal bearing. *** 3-bearing.

MOTOR GENERATOR SETS

Qu.	KW	Make	R.P.M.	Volts DC	Volts AC
1	2400(3-U)	Al.Ch.	720	600	4800/240
1	1500	Whse	514	250	4600/2300
1	1500(3-U)	Al.Ch.	720	600	2200
1	1500	Whse	720	600	2200
2	1000	G.E.	514	575	4000/2300
1	750	Whse	900	600	2300
1	700(3-U)	G.E.	720	250	2300 440
1	500(3-U)	Whse	1200	120/240	4000,2300
1	500(3-U)	Ideal	1200	120/240	4000/2300
1	500	C.W.	720	575	2300/440
2	500	C.W.	720	250/275	2300,440
1	200	Ridgway	900	275	2300
1	155	G.E.	720	250	2300/440
1	150	Al.Ch.	1200	250	2200/440
1	100	Ridgway	1200	275	4000/2300
1	85	C.W.	1200	250	2300/440
1	75	Star	1200	250	440/220
1	75	Al.Ch.	900	250	2300
2	50	Burke	1800	240	440/220
1	45	Whse	1200	125	440/220
1	30	Reliance	1800	250	440/220
2	25	Whse	1200	120,240	440/220
1	20	Reliance	1800	250	440/220

3-U—3-unit set.

We can also furnish any of the above with exciters and VARIABLE VOLTAGE CONTROL engineered and rebuilt to suit your requirements.

ROTARY CONVERTERS

2025/2365 K.W. 225/285-V D.C., G.E., 9000 Amp., 450-R.P.M., with booster.

2760—K.V.A. Trans., 6900-V, 3-PH., 60 CY., complete control & C.D. distribution cubicles.
Will Rewind Transformer to Suit Your Current.

TRANSFORMERS—(OIL COOLED)

Qu.	K.V.A.	Make	Type	Phase	Voltage
1	7500	G.E.	H	3	23000/29700 13800/12000
2	4500	G.E.	H.T.	3	27000/13500 2300
1	3750	Whse	S	3	67000–34400/2400
3	500	G.E.	H	1	13200/11880 220/440
3	130	G.E.	H	1	19000/9500 550/2200
3	100	Whse	Auto	1	2300/5160 1385/2300
3	100	Whse	S.S.	1	12075/10955 230/460
2	50	Wagner	H.E.	1	13200/11880 575/255
3	50	Al.Ch.	OISC	1	22000 220

DIRECT CURRENT MOTORS

Qu.	HP	Make	Type	RPM
1***	3000	Whse	Encl(Rev)	600
1***	2400	Whse	Encl(Rev)	600
6***	1500	Whse	Encl(Rev)	600
4***	1200	Whse	Encl(Rev)	600
1***	1250	Whse	Mill(Rev)	300,600
4***	800	Whse	Encl(Rev)	600
1	350	G.E.	CD169	1150
1	325	Whse	QM	450/900
1	200/250	El.Dy.	No. 22	400/1200
1	200	Whse	Mill(Rev)	300/1200
1	180	G.E.	MPC	400
1	150	Al.Ch.	Mill(Rev)	400/1200
2*	150	Cr.Wh.	83H	800
1***	125	Whse	SK-190	600
1	100/125	Rel.	1905F	300/1200
2	100	Rel.	1050T	400/1200
1	90/160	G.E.	MPC	625/1125
1*	50/75	Rel.	1995F	300/1200
1	50	G.E.	RF16	300/900
1*	30/75	Whse	SK131L	400/1200
1	40	Al.Ch.	E127	850/1750
1	35	G.E.	CD125	400/1200
1	35	G.E.	CD147	300/1200
2	35	G.E.	RF14	400/1500
1	35	Rel.	T	250/1000
1	32½	Whse	SK150	400/1200
1	30	G.E.	CDM105	875/1750
2	27½	El.Dy.	158	450/1350
1	25	G.E.	RF13	400/1600
2	25	G.E.	CD123	400/1200
1	25	Whse	SK111L	250/1000
3	20	Al.Ch.	E130	400/1200
3	20	Whse	SK130	375/1500
3	20	G.E.	CD123	300/1200

Above are all 230 VDC except where marked ***.
*** Pedestal Bearing 525/600 VDC Mill Design Re (designed for mill reversing service). *T.E.F.C.

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KVA	VOLTAGE RATING
¾ to 25	450 to 117
3 to 25	225/450 - 117/234
3 to 25	600 to 120/240
PHASE CHANGERS	
6 to 50	220 or 440 to 220

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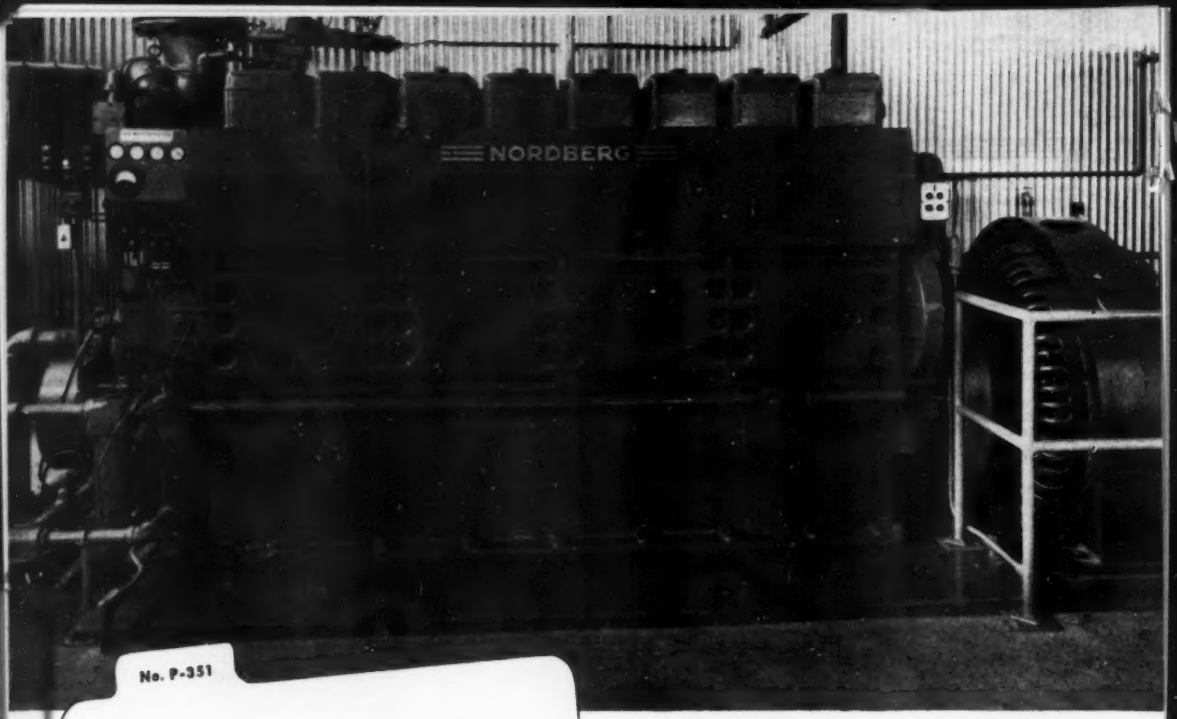

No. P-351

THE CASE OF THE STAND-BY DIESEL that paid for itself in *FIVE MINUTES*

THIS 8-cylinder 720 hp Nordberg Supercharged and Intercooled Diesel is connected to a 500 kw AC generator for emergency power needs at the big Owens-Corning Fiberglas plant at Santa Clara, California.

With the process at this particular plant, an interruption of power for more than 5 minutes' duration could raise havoc with the processing machinery. To guard against any such shutdown caused by a failure of purchased power, the Nordberg Diesel is ready to take over the plant load at once. To make sure full power is instantly available, the engine is constantly maintained at operating temperature. Once each day the engine is started, paralleled with purchased power, and the plant load taken over for a short period... assuring its readiness, and familiarizing personnel with rapid operating procedure.

Since this installation was made, eight main power failures have occurred without warning. *In each case, the Nordberg stand-by unit was on the line and supplying emergency power within three minutes.* This service has more than saved the Diesel's original cost.

Here, then, is proved Nordberg Dependability ... *Ready for instant service!*

NORDBERG MFG. CO.
Milwaukee 7, Wis.

NORDBERG DIESELS FOR EVERY POWER REQUIREMENT....10 TO 9600 H.P.

For regular or emergency service, you can't beat the advantages of Nordberg Diesels . . . they can be added to the line quickly, and can be held ready for instant service without exorbitant stand-by expense . . . and in the complete line of Nordberg two and four-cycle Diesel engines, including both oil and gas burning types, you will find exactly the right unit to meet your present and future power requirements . . . in sizes up to 9600 hp.

P-351

BUSCH-SULZER
A DIVISION OF NORDBERG

NORDBERG
DIESEL ENGINES

From interpretation to installation . . .

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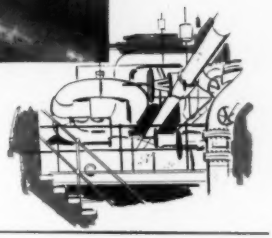
assures greater customer satisfaction through its five-point program of

Quality Control



The bending operation illustrated above is an example of Grinnell QUALITY CONTROL *in action* . . .

The tubing shown is made from a chromium alloy steel forging, turned and bored. Outside diameter is 14¾ inches; wall thickness 2⅜ inches. Temperatures of the tubing within the bending furnace were maintained and controlled within 20°F of specified temperatures. Bending was done with such skill and rapidity as to permit a temperature drop of only 100°F at the inside surface of the tubing. Maximum thinning was only .06 inch.

Designed for a central station power plant to accommodate 1500 PSI and 1050°F, this is typical of Grinnell's engineering knowledge which assures prefabricated piping of the right kind — for all types of installations no matter how complex.

QUALITY CONTROL is the result of Grinnell's 100 years of practical experience in the field of piping. Delivery of prefabricated piping subassemblies to exacting engineering requirements which meet all governing code requirements is assured by Grinnell Quality Control, which includes:

- Interpretative engineering
- Metallurgical research
- Specialized facilities
- Skilled personnel
- Rigid inspection

ECONOMY of specifying Grinnell prefabricating piping results from:

- One source for design, interpretation and fabrication
- Coordination of shop production under ideal conditions
- Elimination of waste by paying only for finished material delivered
- Reduction in field erection time

Write for the booklet, Grinnell Prefabricated Piping.

GRINNELL

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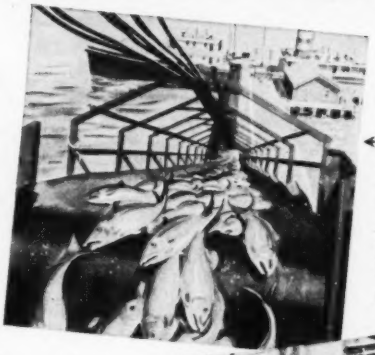
You can belt down handling costs

NO MATTER what the material you have to move—inside or outside your plant—it'll pay you to investigate conveyor belts. The G.T.M.—Goodyear Technical Man—can analyze your problems drawing on experience gained from successful installations throughout industry—match *your* problems with others to prove that conveyors can be the most economical cargo-handlers. And he can choose from a wide selection of belt constructions to specify the one that will give you the longest, most trouble-free service on your particular job. Get in touch with the G.T.M. today by calling your nearest Goodyear distributor, or writing Goodyear, Akron 16, Ohio.



THREE TYPICAL G.T.M.-SPECIFIED CONVEYORS THAT ARE CUTTING COSTS

◀ Old-style chain conveyors *outperformed by a Goodyear conveyor 3 to 1!* Over 1,000 tons of fish per hour are carried into the processing plant of this fertilizer maker, at lower cost per ton than ever before.

Paper mills everywhere are turning to conveyors to handle logs, chips and other raw materials. Here, too, the G.T.M. has made appreciable savings by designing systems to replace former materials-handling systems, ▼ operate at lower cost.

▲ Assembly-line operations can be conveyorized, too—with Goodyear's CHEMIGUM belts that withstand the attack of oil 50 times as well as natural rubber. That means longer life—lower cost—fewer interruptions of output.

GOODYEAR INDUSTRIAL RUBBER PRODUCTS

GTM-Specified CONVEYOR BELTS

A few of the materials and service conditions that can be handled

- Single flights up to 5 miles; lifts to 1500'
- Extremely abrasive materials
- Hot materials
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